

QT  
H496t  
1889

**TABULATED MANUAL**  
—OF—  
*Anatomy, Physiology and Hygiene,*  
—BY—  
**GEORGE W. HENDERSON,**

QT H496t 1889

61320570R



NLM 05046432 6

NATIONAL LIBRARY OF MEDICINE

SURGEON GENERAL'S OFFICE  
LIBRARY.

ANNEX

Section

No. 113,  
W. D. S. G. O.

No. 292037

8-513







A  
TABULATED MANUAL  
OF  
Anatomy, Physiology and Hygiene,

TOGETHER WITH

The Effects of Alcohol Upon the System,

Clearly and Scientifically Stated.

ESPECIALLY DESIGNED FOR THE USE OF TEACH-  
ERS AND STUDENTS IN TEACHING, IN  
REVIEWING, AND IN PREPARING  
FOR EXAMINATIONS.

BY

GEORGE W. HENDERSON,

Author of the

“REVISED GOLDEN CHAIN,” and

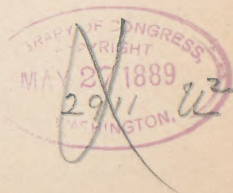
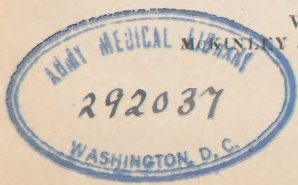
“A VEST-POCKET MANUAL OF CIVIL GOVERNMENT.”

“*Know thy Opportunity.*”—Pittacus.



Vaughnsville, Ohio:

MOSKOWITZ & HENDERSON, PUBLISHERS,  
1889.



QT  
H496t  
1889

---

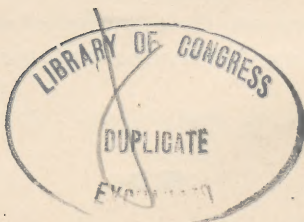
Entered According to Act of Congress,  
in the year 1889,  
By MCKINLEY & HENDERSON,  
In the office of the Librarian of Congress, at  
WASHINGTON, D. C.

---

---

RECORD STEAM  
JOB PRINTING HOUSE,  
Ada, Ohio.

---



TO E. B. McKINLEY, M. D.

MY DEAR PRECEPTOR :

G<sup>N</sup> affectionate remembrance of your personal friendship and the great interest you have always taken in educational matters, I beg leave to dedicate this Manual to you. I wish it were more worthy of the honor you do me in granting me this privilege. Please to accept it as a mark of the highest esteem in which you are held by the author for your aid and support to his every honest endeavor.

I am Yours Fraternally,

GEORGE W. HENDERSON.



## PREFACE.

**T**HIS Manual is the outgrowth of a series of notes made by the author through a long course of study. His experience teaches him that most books of this class now in use treat the subjects in fragments in too many different places. Believing that a judicious abridgment that does not slight the essential facts of the subjects treated can not be considered other than a benefit to any department of science, the importance and convenience of having all the essential points in relation to any particular subject tabulated or placed immediately under it can not fail to be appreciated.

This arrangement will greatly facilitate a rapid acquirement of such things as should be thoroughly known in order to pass a rigid examination or to give instruction. The object of this Manual is not to teach *new* facts, but those which are already known to science in such a manner as to be easily comprehended for the purpose of aiding teachers and students in memorizing and teaching them. The immediate end the student is diligently seeking to obtain is to pass his examinations in a creditable and satisfactory manner. The chief end the teacher is diligently endeavoring to obtain is to bring his teaching within the grasp of his pupils. These facts have been carefully taken into consideration by the author in preparing the following pages. To give the names of all the authors consulted in the preparation of this work would needlessly encumber its pages. Neither time, patience, nor thorough research have been spared to verify every statement made.

Hoping it may contribute to lighten the labors of his fellow teachers and students, in teaching, in reviewing, and in preparing for examinations, the author commits this little Manual into their hands; appealing to their indulgence for any short-comings, and wishing them success in preparing for the greatest possible usefulness and improvement both now and forever.

GEORGE W. HENDERSON.

Waghnsville, O., January, 1889.



## ERRATA.

---

Page 27, point 2, read "1618" instead of "1819."

Page 42, point 6, read "tarsal" instead of "metatarsal."

Page 45, point 6, read "fossæ" instead of "fossa."

Page 52, point 10, read "centrifugal" instead of "centripetal."

Page 59, Table, 1st column, read "portio" instead of "portis."

Page 60, point 9, "Aponeuroses" instead of "Apomeuroses."

Page 66, point 4, read "fraenum" instead of "trænum."

Page 70, point 7, read "food" instead of "blood."

Page 71, Table, 4th column, read "thoracic" instead of "thorax."

Page 74, Table, 1st column, read "mucus" instead of "mucous."

Page 76, point 9, read "ductus" instead of "ducts."

Page 77, point 13, read "pre" instead of "per."



# Introductory.

## ANATOMY.

1. From (1) *ana*, through, and (2) *tome*, a cutting.
2. Treats of the structure of organized beings, being learned by dissection.
3. It is divided into (1) *Human*, relating to man, (2) *Comparative*, relating to inferior animals.
4. It is divided also into (1) *General*, (2) *Descriptive*.
1. General Anatomy gives structure and physical properties without reference to form or situation.
2. Descriptive Anatomy, the shape, position, and connection of the parts of the body.

## PHYSIOLOGY.

1. From (1) *phusis*, nature, and (2) *logos*, a discourse.
2. It signifies in modern application *the study of life*.
3. Human Physiology, the study of the functions exhibited by the human organization in a state of *health*.
4. It is divided into (1) *General*, (2) *Special*.
1. General Physiology treats of the general laws of life.
2. Special Physiology, of the functions of particular organs.

## HYGIENE.

1. From *hugieinon*, health.
2. It treats of the conditions most favorable to health, *i. e.*: what is best calculated to secure and preserve a healthy condition of the body.
3. No health,—no energy, no vigor, no happiness.
4. The art of preserving health is surely one of the most important subjects for the special consideration of mankind.



5. *Human Nature* consists of four principal and eminent divisions,—*physical, intellectual, moral, and devotional*. They are dependent upon each other; if one suffers, all the others suffer with it, and man is dwarfed or incomplete, in proportion as he is deficient in any of these parts. Hence, look well to your physical, intellectual, moral, and devotional well-being.

#### DEFINITIONS.

1. *Osteology*, an account of bones; (2) *Myology*, of muscles; (3) *Neurology*, of nerves; (4) *Angiology*, of veins and arteries; (5) *Ichorology*, of lymphatics and secretion; (6) *Splanchnology*, of the internal parts; (7) *Histology*, of the minute structure of the human body; (8) *Pneumonology*, of the vocal and respiratory organs; (9) *Adenology*, of the glands; (10) *Dermatology*, of the skin; (11) *Syndesmology*, of the joints.

2. A *function* is the *action* of a tissue or organ.

3. *Organ*, part of an organized body.

4. *Apparatus*, a collection of organs, designed to produce a certain result.

5. *Cells* compose tissues, and *tissues* compose organs; collectively, an *organized being*.

## ANATOMY AND PHYSIOLOGY.

### CELLS.

1. They are the type of the *earliest form of life*.

2. The entire body grows out of, and for the most part, is made up of, cells.

3. Their *shape* is either (1) spheroidal, (2) flat, (3) elongated, (4) cylindrical, (5) fusiform, (6) stellate.

4. An *egg* without the shell is a good example of a cell on a very large scale; *i. e.*, cell wall (soft shell), protoplasm (white of egg), nucleus (yolk) and nucleolus (germ spot).

5. Very small when first formed, enlarging toward maturity.
6. They have a limited period of growth.
7. They *multiply* in three ways; viz :
  1. By *hour-glass contraction*, separating in the middle.
  2. By *division of nucleus* within the cell.
  3. *Denovo*, from the protoplasm.
8. They vary in size from  $\frac{1}{3000}$  to  $\frac{1}{300}$  of an inch in diameter.
9. The cell *substance* is albuminous, insoluble in water.
10. They are the fundamental structural elements of which the *tissues* are composed.
11. The cell substance is known as *bioplasm*, *sarcode*, etc.
12. In *old cells*, their substance undergoes various transformations, partly replaced by fat-globules, pigment, and crystals.
13. Cells are the "*Original Structural Elements*."

#### EPITHELIUM.

1. There are four kinds, viz :
  1. Pavement,
  2. Columnar,
  3. Spheroidal,
  4. Ciliated.

#### PAVEMENT EPITHELIUM.

1. Known also as *tassellated*.
2. Flat, nucleated cells of various kinds.
3. On surface of the skin,
4. On lining membrane of the blood vessels,
5. On all the serous cavities except the ventricles of the brain,
6. In the ducts,
7. On many of the mucous membranes.
8. Function, (1) *Secretion*, (2) *Smoothness*.

## COLUMNAR EPITHELIUM.

1. Cylindrical cells set together.
2. It covers the mucous membrane of the gastrointestinal tract and its glands.
3. Its functions are : 1. To secrete from the blood.
2. To secrete from the alimentary fluid. 3. To insure smoothness.

## 4. SPHEROIDAL EPITHELIUM.

1. Circular cells,
2. Their contents are granular,
3. Found in secreting glands.
4. Its functions are : 1. Secretion, 2. Smoothness.

## 5. CILIATED EPITHELIUM.

1. May be any of the preceding forms.
2. It stands up from the free surface.
3. Found in respiratory tract from nose downward,
4. In eustachian tube,
5. In ventricles of the brain,
6. In the tympanum.
7. Its functions are : 1. To moisten ; 2. To insure a smooth surface.

## 6. BASEMENT MEMBRANE.

1. A very thin layer of *protoplasm* which is "the formal basis of all living bodies,"
2. Resembles clear gelatine in color.
3. Structureless,
4. Composed of coagulated albumen,
5. It is often not more than the  $\frac{1}{26666}$  of an inch in thickness.
6. In this membrane the *epithelium* is imbedded.



We shall do well to notice here that the arrangement of the epithelium and basement membrane together with the fibro-areolar tissue make up the following structural elements :

1. Mucous membrane,
2. Synovial membrane,
3. Serous membrane,
4. The inner coats of blood vessels,
5. The lymphatics,
6. The ducts of all glands,
7. The skin.

#### TISSUES.

1. The *connective* tissues are, (1) Fibrous (2) Areolar, (3) Cartilaginous.

2. The fibrous tissue has two forms :

1. White fibrous,
2. Yellow fibrous.

#### 1. WHITE FIBROUS.

1. Widely diffused.
2. Developed from cells.
3. Consists of interlacing fibers.
4. It enters into the formation of nearly every organ.

5. It forms nearly the whole of the investing membranes ; *i. e.* fascia, periosteum, neurilemma, investing membranes of the glands and of the eye, also tendons and ligaments (yellow interwoven to some extent in the latter).

#### 2. YELLOW FIBROUS.

1. Yellow, elastic.
2. Elasticity, its chief characteristic.
3. Fibers branch and anastomose freely with each other.

4. Organs formed almost entirely of this tissue are

- (1) Ligamenta subflava of the vertebrae.
- (2) Elastic ligaments of larynx.
- (3) Middle coat of arteries.
- (4) Ligamentum nuchea.
- (5) Vocal chords.

#### AREOLAR.

1. Fibers interwoven in every direction, with spaces or cells between.

2. Called "Cellular" or "Cellular membrane."

3. Forms a ready exit for inflammatory and other fluids effused.

4. In most situations it contains fat.

5. The spaces contain a fluid resembling serum.

6. The whole tissue forms an unbroken membrane.

7. It enters into the composition of all organs.

8. The spaces all open freely into each other.

9. Great excess of fluid produces general dropsy.

#### ADIPOSE TISSUE.

1. Vesicles formed by an extremely delicate structureless membrane either round (not subjected to pressure) or flattened (subjected to pressure).

2. Each vesicle is filled with fat, held together by fine connective tissue and supplied by capillary blood vessels.

3. It gives roundness and beauty of form.

4. None within the skull, lungs and eyelids.

For muscular and nervous tissue see *Muscles* and *Nerves*.

## CHEMICAL COMPOSITION OF BODY.

NAME.	PER CENT AGE	WHERE FOUND.
Oxygen . . .	72	Lungs and blood . . . . .
Hydrogen . .	9.1	Stomach and intestines . . . . .
Nitrogen . .	2.5	Intestines and blood . . . . .
Chlorine . .	0.85	In all solids and fluids . . . . .
Fluorine . .	.08	Bones and teeth . . . . .
Carbon . . .	13.5	Expired air of lungs, lungs, intestines, exhalation from skin . . . . .
Phosphorus	1.15	In brain; albumen, fibrin, blood, etc.
Calcium . .	1.3	Lymph, chyle, saliva, blood, bones and teeth . . . . .
Sulphur . .	1476	Gelatine, fibrin, saliva, sweat, albu- men and casein . . . . .
Sodium . . .	.1	All solids (except enamel) and fluids.
Potassium .	0.26	In muscles, saliva, gastric juice, etc.
Iron . . . . .	.01	In the blood globules . . . . .
Magnesium .	0.012	In all solids and fluids . . . . .
Silicon . . .	.0002	Blood, hair, and bones . . . . .
Manganese .	trace	Bones, nails, and hair . . . . .

Number of *chemical elements*, 15 to 18. Number of *proximate principles*, about 100. *Water*, 70 % of body-weight; in all solids and fluids; gives solubility, promotes chemical changes, and is eliminated by the kidneys, lungs, and skin.

*Animal Heat* is produced by a combination of oxygen with carbon in all tissues of the body in common with all the organic functions and chemical changes.

*Mean Normal Temperature*, 98.6 Fahr.

## OXYGEN.

1. An elementary gaseous body, discovered in 1774 by Scheele and Dr. Priestly.

2. It is the most widely diffused of any of the elementary bodies.

3. It is necessary to our existence.



4. Found in air mixed with nitrogen (About 23 to 73).

5. Found in water with hydrogen (About 8 to 1 by weight).

6. Pure oxygen causes great fever and excitement amounting to madness.

7. United with carbon and hydrogen of coals, causes a more rapid combustion and increased heat.

8. Although non-combustible itself, it is the most powerful supporter of combustion.

9. It is found in the tissues, in the blood and in various compounds called oxides.

10. When we exercise, the carbon in the blood and oxygen inhaled causes greater combustion, and hence increased heat: *i. e.*, oxygen is absorbed into the arterial blood by the hæmaglobin, being disengaged during nutrition.

#### HYDROGEN.

1. An elementary gas.

2. The lightest of all known bodies.

3. It will not support life, nor combustion.

4. It chiefly exists in water.

5. It is never found but in a state of combination. As, with oxygen in water, with chlorine in hydrochloric acid, etc.

6. 7 or 8 parts of air to 1 of gas produces the greatest explosive effect; more or less diminishes the effect.

7. The effect of its inhalation on the human system is general prostration.

8. Composition of water first discovered in 1781 by Cavendish.

#### NITROGEN.

1. An elementary gaseous body.

2. Found chiefly in the air.

3. In most animal matter, probably derived from

nitrogenized food, and held in solution in the plasma.

4. It will not burn, but will support combustion.

5. It is not a constituent of the vegetable acids, but is found in most of the vegetable alkalies.

#### CARBON.

1. An elementary body.

2. Said to be pure in the diamond, and almost pure in charcoal.

3. When burning it gives off carbonic acid.

4. *Carbonic acid*, then, is the union of carbon and oxygen.

5. It is sent out of the lungs by compressure and mingled with the air; also exhaled from the skin.

6. *Charcoal* is made from wood by the application of heat without the admission of air, expelling the oxygen and hydrogen.

7. *Ivory Black* (Animal Charcoal) from the bones of animals heated generally in iron cylinders.

8. *Coke*, is coal divested of its hydrogen.

#### THE BLOOD.

1. Blood-corpuscles, blood-disks, blood-globules and blood-cells, all mean the same thing.

2. Total amount of blood in the body is about  $\frac{1}{3}$  of body weight.

3. A fluid holding large numbers of corpuscles in suspension.

4. It is purple in the veins.

5. It is scarlet in the arteries.

6. Slightly alkaline; saltish to the taste.

7. Specific gravity, 1055.

8. Consists naturally of two parts,—(1) *Liquor Sanguinis* or *Plasma* composed of *water*, *albumen* (nutritious principle) *paraglobulin*, *fatty matters*, *fibrinogen*, *organic matters* and *mineral salts*, (2) *Red Corpuscles*, composed of *water*, *globulin*, *hæma-*

*globin* (the coloring matter, an albuminous compound) mineral salts, extractives and fatty matter, and *originate* from colorless nucleated corpuscles closely resembling white corpuscles, and “finally *destroyed* in the spleen.”

9. After the blood is drawn the two parts are; (1) The *clot* (corpuscles+fibrin of plasma). (2) The *serum* (remainder of the plasma).

10. The corpuscles consist of an elastic colorless frame work (stroma) in which is entangled the coloring matter (hæmaglobin).

11. Use of corpuscles, to carry oxygen to the tissues.

12. The corpuscles are of two kinds;

(1) *Red*,

(2) *White*.—Proportion, 300 to 1.

13. The corpuscles are circular, biconcave disks.

14. There are about 5,000,000 disks in a cubic millimeter of blood (the cubic  $\frac{1}{25}$  of an inch).

15. Blood coagulates in the body after breathing has ceased in from 12 to 24 hours.

16. It contains all the necessary elements for the repair of the tissues.

17. It also conveys waste principles absorbed from the tissues to the excretory ducts which eliminate them from the system.

18. Without blood, no tissue activity, no life, no mind, no vigor.

#### VASCULAR SYSTEM, OR CIRCULATORY APPARATUS, CONSISTS OF

1. The Heart,
2. The Arteries,
3. The Capillaries,
4. The Veins.

#### THE HEART.

1. A hollow, muscular, pyramidal organ.
2. Enclosed in *pericardium*, which consists of an outer fibrous coat and an inner serous coat; the latter



consisting of a parietal and visceral layer and secretes normally about one drachm of thin fluid, for lubricating its surfaces.

3. Lined by *endocardium*, a serous membrane, continuous with lining membrane of the great vessels.

4. Joined to vertebral column by large blood vessels from the fourth to the eighth dorsal.

5. Free except at base.

6. Weight 10 to 12 ozs. in males, 8 to 10 ozs. in females.

7. It consists of four cavities.

(1) Right auricle, (3) Left auricle.

(2) Right ventricle (4) Left ventricle.

8. The auricles occupy the basal end.

9. The ventricles occupy the body and apex.

10. A longitudinal septum divides it into right (pulmonic) and left (systemic) heart.

11. Each chamber divided by a transverse constriction into the auricle and ventricle.

12. Each cavity holds about 2 to 3 fluid ounces.

13. The cavities in the right side, triangular shape.

14. The cavities in the left side, oval in shape.

15. Fibrous Zones.

1. Four rings of fibro-elastic tissue,

2. At opening between auricles and ventricles,

3. At beginning of aorta and pulmonary artery.

16. In the auricles, the walls are thin and bluish,

17. In the ventricles, thicker with fleshy columns (*columnæ carneæ*) arising on interior.

18. *Valves* formed from the *endocardium*, (for their position, see CIRCULATION TRACED).

19. Number of valves: Six semilunar, three tricuspid, and two bicuspid or mitral.

20. The fibers of the heart cross in at least three different directions.

21. The heart is the connecting link between the voluntary and involuntary muscles, *i. e.* :

- (1.) It is intermediate in *structure*,
- (2) It is *involuntary* in action,
- (3) Composed of *striated* muscle.
- (4) The sheath is *wanting*.

22. There are two openings to each ventricle, one in, and one out; *both* at upper part of the ventricle.

23. Capacity, nearly a pint.

24. Average size,—five inches long by four inches wide by two and a half inches thick.

25. The left ventricle beats with a force equal to from 52 to 60 pounds at every stroke. At 80 beats per minute, one ounce being received and thrown out at each beat, it will equal 5 pounds per minute, (more than a barrel per hour).

26. The force of the heart is ascertained by multiplying the pressure in the aorta (4 pounds) by the area of the inner surface of the left ventricle (about 13 inches.)

27. The work done by the entire heart is estimated by multiplying the amount of blood sent out from the right and left ventricles at each contraction by the pressure in the pulmonary artery and aorta respectively.

#### Demonstration :

1. The right ventricle in forcing out  $\frac{1}{4}$  lbs. of blood must overcome a pressure in the pulmonary artery sufficient to support a column of blood three feet high, *i. e.*, must raise  $\frac{1}{4}$  lb. 3 feet, or  $\frac{1}{4}$  times 3, or  $\frac{3}{4}$  lb. one foot.

2. The left ventricle contracting sends out  $\frac{1}{4}$  lbs. and must exert or overcome a pressure in the aorta sufficient to support a column of blood 9 feet high, *i. e.*,  $\frac{1}{4}$  lb. 9 ft. or  $\frac{1}{4}$  times 9 or  $2\frac{1}{4}$  lbs. one foot.

3. Each contraction exerts a force sufficient to raise 3 foot pounds; 72 contractions per minute would

be 72 times 3, or 216 foot pounds, in one hour ( $216 \times 60$ ) or 12,960 foot pounds; in 24 hours ( $12960 \times 24$ ) or 311,040 foot pounds or  $138\frac{1}{2}$  foot tons.

28. The nerves of organic life cause its contraction (systole) and dilation (diastole), propelling blood to all parts of the system.

29. The heart is influenced by age, exercise, digestion, posture, etc.

30. Beats oftener in the young than the old.

31. The principal nerves modifying the action of the heart are :

(1) The Pneumogastric,

(2) The Accelerator.

32. The time required for the entire mass of blood to pass through the heart is 58 pulsations or 48 seconds.

33. Average pulsations in the adult per minute, in males, 72; in females, 80.

#### ARTERIES.

1. A series of branching tubes.

2. They convey blood from heart to all parts of the body, *at an average rate of 16 inches per second.*

3. They have three coats :

1. Internal, (epithelium and basement membrane).

2. Middle, (fibrous, circular coat).

3. External, (cellular, or tunica adventitia).

4. They are endowed with (1) Contractility; (2) Elasticity.

5. They therefore can accommodate themselves (1) To the blood coming into themselves; (2) Equalizing the blood pressure.

6. The pressure of blood is greatest in the large arteries, decreasing towards the capillaries.

7. The blood pressure is influenced, *i. e.*, increased or lessened, (1) By influences acting upon the heart. (2) By the peripheral resistance of the capillaries.

8. The caliber of the blood-vessels is regulated by the *vasomotor* nerves originating in the medulla oblongata.

9. The *pulse* is the distention of the artery, in a longitudinal and transverse direction caused by an injection of blood at the time of the ventricular contraction.

10. How to know when an artery has been severed: (1) Blood is scarlet; (2) Comes forth in jerks.

11. Nourished by the *vasa vasorum*.

#### CAPILLARIES.

1. They inosculate with the arteries and veins.

2. Their diameter varies from  $\frac{1}{80000}$  to  $\frac{1}{8000}$  of an inch.

3. Their walls are  $\frac{1}{20000}$  of an inch thick, lined by elongated, flattened cells.

4. Through the agency of the capillaries take place, (1) Nutrition; (2) Secretion.

5. The rate of the blood current through them is *one inch in 30 seconds*.

6. Corpuscles: (1) The red keep in the middle of the stream; (2) The white adhere to their walls.

7. Passage of blood through them is mainly due (1) To the force produced by contraction of the heart; (2) To the elasticity of the arteries.

8. They branch and communicate in every possible direction.

9. They distribute the blood to the inmost recesses of the tissues.

#### TABLE OF ARTERIES.

*All the arteries originate from the pulmonary artery and the aorta.*

The PULMONARY ARTERY emerges from the right ventricle of the heart, soon dividing into a right and left branch, ramifying by innumerable branches through the *lungs*.

The AORTA arises from the *left* ventricle of the heart giving off immediately at its origin the anterior and posterior *coronary* arteries. It then proceeds to supply every part of the body with blood in the following order :

- (1) It forms an arch,
- (2) It then descends along the spine; and,
- (3) It divides into the two common iliac arteries.

(1) THE ARCH OF THE AORTA gives off three branches:

1. The *innominata*, dividing into right common carotid and right subclavian.
2. The *left common carotid*.
3. The *left subclavian*.

I. The common carotids are divided into external and internal.

The *external* carotids give off

1. The superior thyroid,
2. The lingual,
3. The facial,
4. The inferior pharyngeal,
5. The occipital,
6. The posterior auris,
7. The internal maxillary, from which arise the spinous artery of the dura mater, the lower maxillary, and several branches about the palate and orbit.

8. The temporal.

The *internal carotid*, gives off

1. The ophthalmic,
2. The middle cerebral,
3. The communicans, inosculating with the vertebral.

II. THE SUBCLAVIANS, give off

1. The internal mammary, from which arise the thymic, comes phrenici, pericardiac, and phrenico-pericardiac.

2. The *inferior thyroid* giving off the tracheal, ascending thyroid, and transversalis humeri.



3. The *vertebral*, ascending on each side through a canal formed by foramina in the *transverse processes* of the cervical vertebræ, and, giving off the anterior arteries of the spinal cord, joins its fellow of the opposite side *within* the cranium to form the basilar artery, from which proceed the anterior cerebelli, the posterior cerebelli, which usually give off the posterior arteries of the spinal cord, the posterior cerebri, and many branches about the brain.

4. The *cervicalis profunda*.

5. The *cervicalis superficialis*.

6. The *superior intercostal*.

7. The *supra scapular*.

As soon as the subclavian artery reaches the *axilla*, it is called the *Axillary* artery and when the latter reaches the *arm* it is called the *Brachial*.

The *Axillary Artery* gives off,

1. Four external (mammary) arteries,

2. The subscapular, dividing into subscapularis interna, and dorsalis scapulæ inferior.

3. The posterior circumflex, and

4. The anterior circumflex, both ramifying about the shoulder joint.

The *Brachial Artery*, gives off,

1. Many lateral branches,

2. The profunda superior (humeri)

3. The profunda inferior, (humeri)

4. The great anastomosing artery ramifying about the elbow joint.

The brachial artery then divides, about the bend of the arm into ulnar and radial, ramifying to the ends of the fingers.

The *Ulnar Artery* gives off,

1. The ulnar recurrent.

2. The posterior interosseous.

3. The anterior interosseous.

The ulnar artery ends forming the superficial palmar arch from which proceed the digital arteries.

The *Radial Artery* gives off,

1. The radial recurrent,
2. The Superficialis volæ,
3. The palmaris profunda, forming deep palmar arch.

B. The *Descending Aorta* gives off

(1) In the *Thorax*,

1. The bronchial, and,
2. The œsophageal arteries (varying in number),
3. The inferior intercostals.

(2) In the *Abdomen*,

1. The inferior diaphragmatic,
2. The cæliac which divides into three branches,

I. The hepatic which gives off before it reaches the liver, (1) the duodeno-gastric, sending off the right gastro-epiploic and (2) the pancreatico-duodenal.

II. The pylorica superior hepatica, giving off (1) the coronaria ventriculi, (2) the splenic which emits the great and small pancreatics, the posterior gastric, the left gastro-epiploic and the vasa brevia.

3. The superior mesenteric,
4. The renal, ("emulgents,")
5. The spermatics,
6. The inferior mesenteric,
7. The lumbar arteries,
8. The middle sacral.

C. The Aorta then bifurcates into the common iliacs each of which divides into an external and internal iliac.

The *Internal Iliac* (hypogastric), gives off,

1. The ileo-lumbar,
2. The lateral sacrals,

3. The gluteal,
4. The obturatory,
5. The umbilical,
6. The uterine,
7. The middle hemorrhoidal,
8. The pudic.

The *External Iliac* gives off,

(1) In the groin,

1. The epigastric,
2. The circumflexa iliaca.

It then passes under Poupart's ligament, and called

The *Femoral Artery*, gives off,

1. The external pudics,
2. The profunda,
3. and 4. The internal and external circumflex.

5. The ramus anastomoticus magnus, ramifying about the knee-joint.

The femoral on reaching the ham is termed the **POPLITEAL** and here gives off the articular arteries. It then divides into the anterior and posterior tibial.

The *Anterior Tibial*, gives off,

1. The recurrent; 2, internal malleolar; 3, external; malleolar; 4, tarsel; 5, metatarsal; 6, dorsalis halicis.

The posterior tibial divides into fibular (peroneal), posterior tibial (properly so called).

The peroneal divides into anterior and posterior.

The *Posterior Tibial* sends off,

1. The nutritia tibiæ; 2, many small branches; 3, and 4, internal and external plantar, giving off the digitals of the toes.

#### VEINS.

1. Return the blood to the heart,
2. They have three coats ;
  1. Internal, (epithelium)

2. Middle, (fibrous),

3. External, (cellular or areolar tissue).

3. The main differences between these and the arteries:

(1) The weakness of the middle coat of the veins,

(2) Veins passive, rather than active organs.

(3) They do not stand open when divided, as arteries do.

4.

#### VALVES.

1. Prevent a reflux of blood by distension,

2. Formed by a reduplication of middle and inner coats of veins,

3. They consist of connective tissue and elastic fibers,

4. They are covered on both surfaces by epithelium,

5. They are semi-lunar in form,

6. Their convex edge attached to wall of vein,

7. Concave margin free,

8. Lie close to the wall as long as the blood flows its natural course,

9. Two valves are generally placed opposite each other, (in some places 3, in others only 1).

10. Most numerous in the lower extremities,

11. They are absent in a number of veins,

5. The veins are nourished by the vasa vasorum,

6. Nerves not usually distributed upon them,

7. All veins finally terminate in the *venæ cavæ* which empties into right auricle of heart,

8. Flow of blood in veins mainly due

1. To action of heart,

2. To contraction of voluntary muscles,

3. To force of aspiration.

## TABLE OF VEINS.

The blood is returned from every part of the body, except the lungs, into the right auricle, from three sources: 1. The *vena cava superior*, bringing it from the head, neck, thorax, and superior extremities. 2. The *vena cava inferior*, from the abdomen and inferior extremities. 3. The *coronary vein* receiving it from the coronary arteries of the heart.

## 1. THE VENA CAVA SUPERIOR.

This vein ends in the superior part of the right auricle, into which it evacuates the blood from the *right* and *left subclavian vein*, and the *vena azygos*. The right and left subclavian veins receive the blood from the head and upper extremities in the following manner:

The veins of the fingers, called *digitals*, receive the blood from the digital arteries, and empty it into the *cephalic of the thumb*, which runs on the back of the hand along the thumb, and evacuates its blood into the external radial.

The *salvatella*, which runs along the little finger, unites with the former, and empties its blood into the internal and external cubital veins. At the end of the forearm there are three veins, called (1) the great cephalic, (2) the basilic, and (3) the median.

The *great cephalic* runs along the superior part of forearm, and receives the blood from the external radial.

The *basilic* ascends on the under side, and receives the blood from the *external and internal cubital veins*, and some branches which accompany the brachial artery, called *venae satellites*.

The *median* is in the middle of the forearm arising from the union of several branches.

The three veins above-named unite above the bend of the arm, and form—



The *brachial vein* which receives all their blood and is continued into the axilla, where it is called—

The *Axillary vein* which receives also the blood from the scapula, and superior and inferior parts of the chest, by the *superior* and *inferior thoracic vein*, the *vena muscularis*, and the *scapularis*.

The axillary vein then passes under the clavicle, where it is called the *subclavian*, which unites with the external and internal jugular veins, and the vertebral vein, which brings the blood from the vertebral sinuses; it receives, also, the blood from the mediastinal, pericardiac, diaphragmatic, thymic, internal mammary, and the laryngeal veins, and then unites with its fellow to form the *vena cava superior* otherwise known as *descending vena cava*.

The blood from the internal and external parts of the face and head is returned, in the manner following, into the external and internal jugulars, which *terminate* in the subclavians:

The frontal, angular, temporal, auricular, sublingual and occipital veins receive the blood from the parts after which they are named, and all converge to each side of the neck and form the *external jugular vein*.

The blood from the brain, and its membranes, is received into the lateral sinuses (or veins of the dura mater) one of which empties through the foramen lacerum in basii cranii on each side into the *internal jugular*, which descends in the neck by the carotid arteries, and receives the blood from the thyroideal and internal maxillary veins, and empties into the *subclavians* within the thorax.

The *vena azygus* receives the blood from the bronchial, superior, œsophageal, vertebral, and intercostal veins, and empties into the *descending vena cava*.

2. VENA CAVA INFERIOR (“ascending vena cava”) is the trunk of all the abdominal veins, and those of the lower extremities, from which parts the blood is returned in the manner following:

The veins of the toes, called *digital*, receive the blood from the digital arteries, and form on the back of the foot three branches: one on the great toe, called cephalic, one on the little toe, called vena saphena, and a third on the back of the foot, called vena dorsalis pedis; those on the sole of the foot empty into the plantar veins.

The three veins on the upper part of the foot coming together above the ankle, form the *anterior tibial*; the plantar veins, with a branch from the calf of the leg, called sural vein, form the *posterior tibial*; a branch also ascends in the direction of the fibula, called *peroneal vein*. The last three named in *italics* unite before the ham into one branch, the *sub-popliteal* vein which ascends through the ham, carrying all the blood from the foot; it then proceeds upon the interior part of the thigh, in which site it is called the femoral (or crural) vein, and receiving many muscular branches, passes under Poupert's ligament into the cavity of the pelvis, where it is called the external iliac vein.

The arteries distributed about the pelvis evacuate their blood (through capillaries) into five or six veins which unite in the pelvis to form the internal iliac vein.

The external iliac vein unites with the internal iliac at the last lumbar vertebra, forming the common iliac; the two common iliacs then form the ascending vena cava, which ascends on the right side of the spine, receiving the blood from the lumbar, sacral, etc., and the vena cava hepatica; and arriving at the diaphragm, it passes through the right foramen, and enters the right auricle of the heart, into which it empties all the blood from the abdominal viscera and lower extremities.

**VENA CAVA HEPATICA.**—Ramifies in the substance of the liver, and brings the blood into the ascending vena cava from the branches of the vena portea, (portal vein) a great vein that carries the blood from

the abdominal viscera into the substance of the liver. The trunk of the vena portea, about the fissure of the liver, in which it is situated, is divided into the hepatic and abdominal portions.

The abdominal portion consists of the splenic, meseraic, and internal hæmorrhoidal veins, which three carry all the blood from the stomach, spleen, pancreas, omentum, mesentery, gall-bladder, and the large and small intestines into the sinus or fissure of the vena portea.

The hepatic portion enters the substance of the liver, divides into innumerable ramifications, which secrete the bile, and the superfluous blood passes into corresponding branches of the vena cava hepatica.

## THE CIRCULATION.

### 1. Cardiac and Pulmonic :

(1) The venæ cavæ receive the systemic venous blood and (2) convey it into the right auricle, (no valves); then (3) it passes into the right ventricle through the tricuspid (auriculo-ventricular) valves to be (4) thrown into the pulmonary artery through the semilunar (pulmonary) valves; then (5) conveyed to the lungs and oxygenized in the capillary plexus about the intercellular structure and the air-cells, and (6) returned by the four pulmonary veins to the left side of the heart, into the left auricle, (no valves); it then (7) passes into the left ventricle through the mitral valve to be (8) forced into the aorta through semilunar valves, and (9) thence to all parts of the system :

2. Discovered by Harvey in 1819.

3. The forces keeping the blood in circulation are,

1. Action of the heart.

2. Elasticity of the arteries.

3. Contractility of the arteries.

4. Capillary force.

5. Respiratory movements.

6. Contractility of voluntary muscles upon the veins.

## RESPIRATION.

1. ORGANS,—(1) Larynx, (2) Trachea, (3) Lungs.

1. LARYNX.

1. Organ of voice.
2. From aperture behind epiglottis to lower border of the cricoid cartilage.
3. Pharynx opens into it.
4. Composed of 5 principal cartilages,—(1) Thyroid, (2) Cricoid, (3) The two Arytenoid, (4) epiglottis.

1. THYROID.

1. The largest.
2. Consists of 2 lateral quadrangular plates, meeting in front, ("Adam's Apple")
3. Connects above with hyoid bone.
4. Connects below with cricoid cartilage.
5. Its structure resembles costal cartilages.

2. CRICOID.

1. Connects above with thyroid.
2. Connects below with trachea.
3.  $\frac{1}{4}$  inch wide in front, 1 inch wide behind.
4. Forms back part of cavity of larynx.
5. Structure, as above.

3. THE TWO ARYTENOID.

1. Small, triangular, and curved.
2. On top and back part of cricoid.
3. Forms articulations with cricoid.
4. At back part of larynx.
5. Structure, as above.

4. EPIGLOTTIS.

1. Composed of yellow fibro-cartilage.

2. Shape,—leaf, rounded at free extremity.
3. Behind, and curving forwards towards tongue.
4. In front of superior opening of larynx.
5. During deglutition completely closes opening of larynx.
6. Connected to back part of hyoid bone and angle reaching between plates of thyroid.

VOCAL CORDS.

1. Composed of yellow elastic tissue.
2. Extent,—from fore part each arytenoid to recessed part of thyroid.
3. There are two kinds,—(1) False, (2) True.

1. FALSE CORDS.

1. Above true vocal cords.
2. Not directly concerned in producing voice.
3. Two in number.
4. Formed by a folding in of the mucous membrane.
5. The saculus laryngis is a pouch on the outside of the false cords, being an extension of the ventricle of the larynx, an open depression between the false and true cords; it secretes a fluid which lubricates the vocal cords.

2. TRUE CORDS.

1. Two in number.
2. Formed of mucous membrane and fibers:
3. The glottis (rima glottis), a fissure between these cords.
4. The glottis varies in size according to the voice, and
  - (1) Length about 1 inch.
  - (2) Width from  $\frac{1}{3}$  to  $\frac{1}{2}$  inch. (less in females)
  - (3) The cords enlarge at 14 or 15 years old. ("change of voice")



(4) Voice is produced by vibrations of these membranes.

(5) A change of  $\frac{1}{1200}$  inch in length produces a change of note.

#### TRACHEA.

1. A cylindrical, cartilaginous and membranous air tube.

2. Flattened somewhat, behind.

3. Extent,—from larynx, level with 5th cervical to opposite 3d dorsal where it divides into

(1) Right bronchus, (2) Left bronchus.

#### 1. RIGHT BRONCHUS.

1. About 1 inch long.

2. Enters right lung opposite 4th dorsal.

3. Divides and subdivides till it ends in the pulmonary lobules.

#### 2. LEFT BRONCHUS.

1. Smaller, but longer than right.

2. Length nearly two inches.

3. Enters root of left lung opposite 5th dorsal.

4. Divides and subdivides till it enters pulmonary lobules.

4. The length of trachea is 4 or 5 inches.

5. Diameter from  $\frac{3}{4}$  to 1 inch.

6. Composed of a series of cartilaginous rings extending  $\frac{2}{3}$  round its circumference.

7. The posterior  $\frac{1}{3}$  composed of non-striated muscular fibers capable of lessening its caliber.

8. Lined by ciliated epithelium.

9. Diameter always less in females.

#### LUNGS.

1. Two in number,

2. One in each lateral cavity of the chest.

3. Separated by heart and other contents of the mediastinum.

4. Shape, conical.

5. *Parts*,

1. Apex,—tapering cone, extending to about  $1\frac{1}{2}$  inches above first rib.

2. Base,—broad, concave, resting on diaphragm,

3. *Two Borders*, viz :

(1) Posterior,—round, broad, fills cavity on each side of spinal column.

(2) Anterior,—thin, sharp, overlapping front of pericardium.

4. *Two Surfaces*, viz :

(1) External, convex and smooth ;

(2) Inner, concave fissure behind, giving attachment to root of lung.

6. *Root*, at middle, and inner surface connecting lung to heart and trachea, and consisting of,

1. Bronchial tube, artery and veins,

2. Pulmonary artery and veins,

3. Pulmonary plexus of nerves,

4. Lymphatics and areolar tissue.

7. *Pleura*, interposed down as low as fourth dorsal,

8. Below fourth dorsal, pericardium is interposed,

9. Right lung larger, shorter, and has three lobes,

10. Left lung smaller, longer, and has two lobes.

11. Weight of both, 42 ounces.

12. Right lung, 2 ounces heavier than the left.

13. They are heavier in males than females.

14. Specific gravity, from 345 to 746.

15. Color, pinkish or mottled in appearance.

16. Color, from deposition of carbonaceous matter in the areolar tissue.

17. Substance, elastic and spongy in texture.

18. Float in water, crepitate when handled owing to air in the tissue.

19. *Structure,*

1. Serous coat, the pleura.

2. Sub-serous areolar tissue, invests entire lung.

3. Parenchyma, little lobules, connected by fibrous tissue.

20. *Air-cells*, from  $\frac{1}{200}$  to  $\frac{1}{70}$  inch in diameter.

21. Walls of air-cells lined internally by tessalated epithelium; covered externally by elastic fibers.

22. Whole number of air-cells, 600,000,000.

23. The air and blood are separated by the walls of the air-cells and capillaries.

24. The lungs receive their *nutrition* from the brachial arteries.

25. The pulmonary capillaries are on the walls and speta of the air-cells.

26. Area of lung tissue, 21,000 square inches.

27. The vital capacity of a person 5 feet, 7 inches high is 230 cubic inches. (Varies with stature).

28. The *movements* of the lungs are called forth by impulses emanating from the medulla oblongata.

29. There passes in and out of the lungs, in 24 hours about 300 cubic feet of air.

30. *Tidal air*, that passing in and out at each inspiration—25 to 30 cubic inches.

31. *Reserve air*, remaining after ordinary breathing but *can* be forcibly expelled—about 100 cubic inches.

32. *Complemental air*, all that can be forced into the lungs plus the tidal air—about 110 cubic inches.

33. *Residual air*, remaining in the chest and cannot be forcibly expelled—about 100 cubic inches.

34. The *oxygen*, imbibed from the air in 24 hours—about 15 cubic feet, or 18 ounces.

35. *Carbonic Acid* exhaled in 24 hours—about 14 cubic feet, or 7 ounces pure carbon.

REMARK :—The first cubic foot of oxygen unites with hydrogen, perhaps, forming water.

36. Nerves,—pneumogastric and sympathetic.

37. Lymphatics,—end at root in bronchial glands.

38. Pulmonary artery conveys blood to lungs.

39. Pulmonary veins convey blood from the lungs.

40. *Function of Lungs*,—(1) To purify the blood, (2) Ultimately, to produce heat, motion and nervous energy.

## BONES.

### 1. *Composition:*

1. Blood-vessels and cartilage.....	33 %
2. Phosphate of lime.....	51 %
3. Carbonate of lime.....	11 %
4. { Phosphate of magnesia.....	} 5 %
{ Chloride of sodium.....	
{ Fluoride of calcium.....	

### 2. *Structure:*

1. Surrounded by the periosteum (vascular fibrous membrane).

2. Lined internally by the endosteum.

3. Arteries,—small and very numerous.

### *Haversian Canals:*

1. From  $\frac{1}{1000}$  to  $\frac{1}{200}$  of an inch in diameter.

2. The larger ones contain marrow.

3. They afford free communication between the vessels of the endosteum and periosteum.

4. Each canal, surrounded by 8 to 15 concentric rings (*lamellæ*) among which are small cavities (*lacunæ*).

5. Canals issuing from the *lacunæ*, the  $\frac{1}{16000}$  of an inch in diameter, are the *canaliculi*, communicating with adjacent *lacunæ*.

6. *Haversian Systems*,—separated by interstitial lamellæ.

7. A Haversian System consists of (1) concentric lamellæ, (2) lacunæ, (3) canaliculi.

8. *Haversian Spaces*, between adjoining systems.

9. Nerves and lymphatics have been traced into the bone substance.

### 3. *Medulla.*

1. That composed of fat (96%) and extractive (4%),—in (1) medullary canal, (2) cancellous texture, (3) larger Haversian canals.

2. That composed of albumen, fibrin, extractive, and fat, (redish in color),—in articular ends of long bones, the diploe, short bones, ribs, &c.

4. *Development.*—Two ways: (1) from cartilage, (2) from membrane.

### 5. *Manner of Development:*

1. Intra-cartilaginous,—the deposition of earthy salts in the interior of the cartilage.

2. Intra-membranous,—a deposition of mineral matter in the membrane.

6. *Centers of Ossification*,—point of deposits.

7. Epiphyses,—become attached to main bone inversely to the order of the appearance of their ossification.

8. Apiphyses,—a regular enlarged, continuous part of the bone.

9. Diaphysis,—that part between the articular ends.

## THE SKELETON.

1.  $\frac{1}{10}$  of body weight.

2. The frame-work of the body.

3. Prevents body from sinking by its own weight.

4. It serves as a basis for the attachment of muscles.

5. Composed of 4 kind of bones,

1. *Long*,—medullary canal in center, and number.....90



2. *Short*,—strength, with limited motion,  
number.....30
3. *Flat*,—form walls around viscera, number...38
4. *Irregular*,—vertebræ, ethmoid, sphenoid,  
&c., number.....39
6. Total number of bones 200 if we include the  
patellæ and os hyoid.

## 7. Again:

1. Spinal column.....26
2. Cranium and face.....22
3. Os hyoides, ribs and sternum.....26
4. Upper extremities.....64
5. Lower extremities.....62

## 8. VERTEBRAL COLUMN.

1. It supports the head,
2. Itself, supported by the pelvis.
3. Its bones are, (1) movable, (2) united.

## 9. MOVABLE VERTEBRÆ.

1. 24 in number,
2. Divided into 3 groups,—(1) *Seven* cervical, (2)  
*Twelve* dorsal, (3) *Five* lumbar.

## UNITED VERTEBRÆ.

1. They enter into the formation of the pelvis.
2. They are coalesced, forming two pieces:
1. The sacrum.
2. Coccyx.

## GENERAL CHARACTERS OF A VERTEBRÆ.

1. *Body*,
1. Forms anterior part.
2. Has small apertures for nutrient vessels,
3. Connected above and below to the bodies of  
the vertebræ by *inter-vertebral fibro-cartilages*.

2. *Pedicles,*

1. Two thin portions of bone,
2. Connect the sides of the body with the *laminæ*,
3. Grooved above and below, forming the *inter-vertebral notches*, transmitting the spinal nerves.

3. *Laminæ,*

1. Two lateral plates,
2. Pass back from posterior part of body,
3. Unite in the middle line forming *spinous process*.
4. Ligamenta sublava attached to upper and lower borders.

4. *Articular Processes,*

1. Four in number,
2. Two on upper and two on lower surfaces of the *laminæ*,
3. At the roots of the transverse processes,
4. Articulate above and below with the transverse processes.

5. *Notches,*

1. Four in number,
2. Two above and two below,
3. Formed by a groove in the *lamina* where it joins the body.
4. The corresponding notches above and below form the *inter-vertebral notches*.

6. *The Foramen,*

1. A ring inclosed by the body and *laminæ*,
2. Called *spinal canal*,
3. Contains spinal cord with its blood-vessels and membranes.

## DEVIATIONS.

1. *The Atlas,*

1. A bony ring, inclosing an irregular foramen, divided into two unequal segments by the *transverse ligament*.

2. The *anterior* segment contains odontoid process of the axis,

3. The *posterior* segment contains the spinal cord.

4. Articulates with condyles of the occipital above, and the axis below.

2. *Axis*,

1. The foramen is heart-shaped with apex posterior.

2. It has a tooth-like (odontoid) process articulating in *front* with ring of atlas, *behind* against transverse ligament, having the check ligaments which extend to the tubercles on the inner aspects of the condyles of the occipital bone attached to its apex.

NOTE:—*Check ligaments* serve to “check” the limit to which rotation of the cranium may be carried.

3. *Peculiar Dorsal*.

1. The First—facet above, demifacet below.

2. The Ninth—demifacet above,

3. The Tenth—one entire facet,

4. The Eleventh—an entire facet, none on transverse process,

5. The Twelfth—ditto.

4. *Seventh Cervical*,

1. Very long, prominent spinous process,

2. Called “vertebrae prominens.”

#### FIXED (united) VERTEBRÆ,

1. Nine in number,

2. The five upper constitute the *sacrum*,

3. The four lower form the *coccyx*.

4. They are united with the innominata.

#### ENTIRE SPINE.

1. Made up of the vertebrae,

2. Average length 27 inches,

3. Viewed sideways it presents four curves, (1) Cervical, (2) Dorsal, (3) Lumbar, (4) Pelvic.

#### THE RIBS.

1. Twelve in number on each side, forming lateral boundary of thorax,
2. Seven are called *true* ribs,
3. Five are called *false* ribs,
4. The two lowest of the false called *floating*,
5. The *true* ribs are connected to the sternum by separate cartilages.
6. The three *upper false* have their cartilages attached to each other and the seventh.
7. The floating have their cartilages *free*.

#### STERNUM.

1. Flat, and elongated,
2. Broader above than below,
3. Narrow in the center.
4. Originally has six segments,
5. In adults has three segments: (1) Manubrium, (2) Gladiolus, (3) Ensiform cartilage.
6. Articulates with 7 pairs of ribs and 2 clavicles.
7. It is the anterior boundary of thorax.

#### OS INNOMINATUM.

1. In youth 3 parts,
2. Aids in formation of pelvis,
3. In manhood a single bone, of irregular shape,
4. Articulates with its fellow, sacrum and femur,
5. *Acetabulum*—a socket in this bone into which the head of the femur fits.
6. In the center of the socket is fixed the round ligament of the "thigh bone."

#### SACRUM.

1. Basis of spinal cord.

2. Wedge-shaped,
3. Composed of 5 vertebræ,
4. In texture, light and spongy,
5. Between the innominata,
6. Articulates with last lumbar and coccyx.

COCYX.

1. Lower extremity of spinal cord,
2. Formed of 4 vertebræ,
3. Articulates with sacrum only.

UPPER EXTREMITY CONSISTS OF

1. Shoulder,
2. Arm,
3. Forearm,
4. Hand.

1. SCAPULA.

1. On upper and back part of the thorax,
2. Extends from the second to the seventh rib,
3. Triangular in shape,
4. *Coracoid Process* hangs over upper and inner part of glenoid cavity.
5. Articulates with clavical and humerus.

2. HUMERUS.

1. Consists of a shaft and two extremities,
2. *Head*—smooth, covered with cartilage, fits into the *glenoid* cavity of the scapula,
3. *Neck*—constricted part of head for capsular ligament.
4. Two tuberosities at top of shaft, with bicipital groove between.
5. Articulates with scapula above, and radius and ulna below.
6. Trochlear surface received into sigmoid cavity of ulna, admitting flexion and extension.



3. ULNA.

1. On inner side of forearm,
2. Longer and stronger than the radius,
3. Upper end articulates with humerus and radius,
4. It is the "small bone of the forearm."
5. The *olecranon process* forms the projection of the elbow and is that much longer than the radius.

4. RADIUS.

1. Larger, but shorter than the ulna,
2. It is external to the ulna, (on thumb side),
3. Articulates with ulna, at elbow and wrist.
4. At the wrist it articulates with the first row of bones, forming wrist-joint.

5. THE CARPUS.

1. Consist of two rows of bones,
2. Four bones in each row,
3. Between forearm and metacarpus.
4. *First row*—(1) Scaphoid, (2) semilunar, (3) cuneiform, (4) pisiform.
5. *Second row*—(1) Trapezium, (2) trapezoid, (3) magnum, (4) unciform.

6. FINGERS.

1. Composed of 3 phalanges,
2. The thumb has 2 phalanges,
3. The first phalanges are 5 in number,
4. The second, 4 in number,
5. The third, (ungual) 5 in number and smallest,
6. Whole number of phalanges, 14.

LOWER EXTREMITY.

1. The Femur, 3. The Fibula,
2. The Tibia, 4. The Patella, 5. The Foot.

FEMUR.

1. Longest, strongest bone in the body.
2. Supports weight of head, trunk and upper extremities.
3. Head received in acetabulum, forming an **enarthrodial** or ball-and-socket joint.
4. Articulates with os innominatum, tibia and patella.
5. *Movements* permitted are—Flexion, extension, adduction, abduction, circumduction and rotation.

PATELLA.

1. A sesamoid bone,
2. Triangular in shape.
3. Base above, apex below,
4. Anterior surface, convex,
5. Posterior surface divided by a prominent ridge.
6. Connected with tibia by the ligamentum patella,
7. On anterior part of lower extremity of femur.
8. Articulates with condyles of femur.

TIBIA.

1. Situated at fore and inner part of leg,
2. Triangular in shape, and larger than the fibula,
3. Articulates with femur, fibula and astragalus.
4. Where it articulates with the femur it is **expanded** from side to side, the condyles of the femur resting upon it.
5. Between the tibia and fibula is the **interosseous** membrane.
6. It is prolonged downward on its inner side, forming the internal malleolus (ankle joint).

FIBULA.

1. Smaller than the tibia and similar in shape.
2. On outer side of leg,

3. In proportion to its length most slender of all long bones,

4. Upper end below level of knee-joint and *excluded* from its formation.

5. Lower end projects below the tibia forming the outer malleolus (ankle)

6. Articulates with tibia and astragalus.

#### TARSUS.

1. Bones composing it are seven,

2. Connected above to tibia and fibula,

3. Forms posterior part of foot.

4. Below it is arched,

5. Articulates in front with the bases of 5 metatarsal bones.

6. The 7 metatarsal bones are,—Calcaneum, Astragalus, scaphoid, cuboid, and internal, middle and external cuneiform.

7. Firmly bound together by a few large, strong ligaments on back and sole of foot.

#### METATARSUS.

1. The middle part of the foot.

2. Composed of 5 long bones,

3. Between tarsus and toes.

#### PHALANGES.

1. Composed of 14 bones,

2. Three bones to each toe, except first.

3. The great toe has only 2 bones.

#### THE CRANIUM.

1. Composed of 8 bones,

1. Occipital,—posterior part of skull.

2. Two Parietal,—lateral parts of head.

3. Frontal,—forehead.

4. Ethmoid,—between eye-sockets.

5. Sphenoid,—across base of brain.

6. Two Temporal,—temples. (See SKULL BONES)

FACE.

1. Composed of 14 bones, towit :

Two Malar,	Two Palate,
Two Nasal,	Two Inferior Turbinated,
Two Superior Maxillary,	The Vomer,
Two Lachrymal,	The Inferior Maxillary.

EAR.

1. Composed of 3 bones, viz :

Incus or Anvil,  
Malleus or Hammer,  
Stapedius or Stirrup.

BONES OF FACE.

1. *Malar.*

1. Prominent part of cheek,
2. At outer and under part of orbit.
3. Of quadrangular form.
4. Articulates with frontal, temporal, sphenoid and superior maxillary.

2. SUPERIOR MAXILLARY.

1. Hollow ; quadrangular in form,
2. Forms facial surface externally,
3. *Nasal process* joins frontal bone,
4. *Alveolar Process* forms lower part of body and is hollowed out into sockets for 8 teeth.
5. *Nasal spine* extends above and between the central incisor teeth.
6. *Antrum of Highmore*—below the orbital plate, and above the alveoli of the molar teeth.
7. Articulates with frontal, ethmoid, nasal, malar, lachrymal, inferior turbinated, palate, vomer, and its fellow of the opposite side.

## 3. LACHRYMAL.

1. At inner and front part of orbit,
2. In size and shape like a finger nail,
3. Articulates with frontal, ethmoid, superior maxillary and inferior turbinated.

## 4. PALATE.

1. Form, quadrangular,
2. Concave,
3. Completes the floor of the nose,
4. Its posterior edge gives attachment to the soft palate, a freely moving partition.
5. It sends up a crest to support the vomer.
6. Articulates with sphenoid, ethmoid, superior maxillary, superior and inferior turbinated, and its fellow of the opposite side.

## 5. TURBINATED BONES.

(Called also superior and inferior spongy portion of ethmoid by some writers).

1. Attached to lachrymal and ethmoid above,
2. Attached to ridge on palate and the superior maxillary below.
3. Helps to complete nasal duct,
4. Helps to enclose the Antrum of Highmore.

## 6. VOMER.

1. In the central line of the nose,
2. It forms part of the septum of the nose,
3. Articulates with sphenoid, ethmoid, superior maxillaries, palate, and lachrymal.

## 7. NASAL BONE.

1. Between nasal processes, superior maxillary,
2. Forms the "bridge of the nose."



3. Articulates with ethmoid, frontal, superior maxillary and its fellow of the opposite side.

8. INFERIOR MAXILLARY.

1. Anterior part forms mental process of chin,  
2. *Symphysis*, a ridge in the center of anterior part.

3. *Alveolar process* on upper edge of body and horizontal rami.

4. Ascending rami, from angle to glenoid fossa of temporals.

5. A dental canal communicates with each alveoli.

6. Articulates at glenoid fossa with each temporal bone.

9. OS HYOIDES.

1. At root of tongue,
2. Corresponds to epiglottis behind.
3. Shaped like a horse shoe.
4. Has no articulations.
5. To it 11 muscles are attached.

ARTICULATIONS, (JOINTS)

1. In number about 200.

2. *Classes*,—

1. Synarthrosis,—immovable, as of cranium.
2. Amphiarthrosis, Synchronosis or Symphysis, having limited motion, as the vertebræ.
3. Diarthrosis,—having free motion.

3. *Varieties of Motion*,—(1) flexion, (2) extension, (3) adduction, (4) abduction, (5) rotation, (6) circumduction, (7) gliding.

4. By *sutures* are meant processes and indentations interlocked together; as inter-parietal, inter-frontal, fronto-parietal, etc.

5. *Gomphosis*,—an articulation by the insertion of a cone-like process into a socket; as, teeth.

6. *Schindylesis*,—the reception of a plate into the fissure of another bone; as rostrum of sphenoid with vomer.

7. *Lateral Ginglymus*,—a pivot process turning within a ring, or a ring turning round a pivot; as superior radi-ulnar and atlo-axoid joint.

8. *Structures* entering into *formation* of joints: (1) articular lamella of bone, (2) ligaments, (3) fibro-cartilage, (4) cartilage, (5) synovial membrane. (See MEMBRANES)

#### LIGAMENTS.

1. Found in nearly all movable articulations.

2. They consist of variously formed bands made up of *white fibrous tissue*, mostly, and have a shining silvery appearance.

3. They are pliant and flexible, yet strong, tough and inextensible.

4. They are the connecting medium between joints.

5. Where the elasticity of the ligament acts as a substitute for muscular power, they consist of *yellow elastic tissue*, as the ligamenta subflava connecting the adjacent arches of the vertebra.

6. *Capsular ligaments* surround joints like a bag, thus preventing any efflux of synovia.

7. *Connecting ligaments* (external and internal) strengthen the union of ends of movable bones.

CARTILAGE, or "Gristle."

1. Consists mostly of chondrine with about 4% bone earth.
2. White, glistening and elastic.
3. It may be,—(1) *Obducent*, covering movable articulations; (2) *Inter-articular*, between articulations; (3) *Uniting*, uniting one bone with another.

9. SHOULDER JOINT.

1. Ball and socket.
2. Head of humerus received into glenoid cavity of scapula.
3. The ligaments preventing displacement are,—(1) Capsular, (completely encircling it), (2) Coraco-humeral, (strengthening upper and inner part of the capsular) (3) glenoid, (around margin of cavity,
4. Lined by synovial membrane, and moistened and lubricated by synovia.

10. ELBOW JOINT.

1. Hinge-joint
2. Trochlear surface of humerus received in greater sigmoid cavity of ulna (flexion and extension), the depression on head of radius articulating with radial tuberosity of humerus; circumference of head of radius with lesser sigmoid cavity of ulna (rotation).
3. Ligaments,—(1) anterior, (2) posterior, (3) internal lateral, (4) external lateral.

11. WRIST JOINT.

1. Arthrodia.
2. Above, are radius and fibro-cartilage,
3. Below, scaphoid, semilunar, and cuneiform.
4. Ligaments,—(1) anterior, (2) posterior, (3) external and (4) internal lateral.

## 12.

## HIP JOINT.

1. Ball and socket.
2. Head of femur received into cavity of acetabulum.
3. Articulating surfaces covered with cartilage, and lubricated by synovia.
4. Ligaments,—(1) Capsular, (around margin of cavity above and neck of femur below); (2) Teres, (fastened about the center of the head of femur blending with transverse); (3) cotyloid, (fills up all inequalities); (4) Ilio-femoral (across front of joint); (5) Transverse, (crosses notch at lower part acetabulum).
5. Movement, very extensive.

## 13.

## KNEE JOINT.

1. Hinge joint.
2. Head of femur above, tibia below, patella in front.
3. Some ligaments outside, others inside.
4. Ligaments outside,—(1) Ligamentum Patellæ, (2) posterior, (3) internal lateral, (4) 2 external lateral, (5) Capsular.
5. Ligaments inside,—(1) External crucial, (2) Internal crucial, (3) transverse, (4) coronary, (5) ligamentum mucosum, (6) ligamenta Alaria, and (7) 2 semilunar fibro-cartilages.

NOTE.—We do not attempt a *full* description of all joints. Simply remember what enters into the formation of joints and the bones that articulate, and you will experience no trouble in understanding and describing articulations. (See ABRIDGMENT).

ABRIDGMENT OF OSTEOLOGY.

NAME OF BONE.	No. of Articulations	No. Muscles Attached	Developm'tal Centers	NAME OF BONE.	No. of Articulations	No. Muscles Attached	Developm'tal Centers
Frontal . . . . .	12	3	2	Trapezoid. . . . .	4	1	1
Parietal . . . . .	5	1	1	Os Magnum . . . . .	7	1	1
Occipital . . . . .	6	12	4	Unciform . . . . .	5	2	1
Temporal . . . . .	5	14	4	Metacarpal . . . . .	19	18	10
Sphenoid . . . . .	12	12	10	Phalanges . . . . .	23	20	28
Ethmoid . . . . .	15	0	3	Vertebra . . . . .	72	39	85
Nasal . . . . .	4	0	1	Sacrum . . . . .	4	5	11
Lachrymal . . . . .	4	1	1	Coccyx . . . . .	1	4	4
Malar . . . . .	4	5	1	Os Innominatum . . . . .	3	3	5
Inf. Turbinated . . . . .	4	0	1	Femur . . . . .	3	23	5
Vomer . . . . .	6	0	2	Patella . . . . .	1	4	ses
Sup. Maxillary . . . . .	9	9	4	Tibia . . . . .	3	10	3
Inf. Maxillary . . . . .	2	14	2	Fibula . . . . .	2	9	3
Sternum . . . . .	16	10	6	Os Calcis . . . . .	2	8	1
Os Hyoides . . . . .	0	11	5	Cuboid . . . . .	4	1	1
Ribs ( $\frac{1}{2}$ ) . . . . .	24	19	34	Astragalus . . . . .	4	0	1
Scapula . . . . .	2	17	7	Scaphoid . . . . .	4	1	1
Clavical . . . . .	3	6	2	Int. Cuneiform . . . . .	4	2	1
Humerus . . . . .	3	24	7	Mid. Cuneiform . . . . .	4	0	1
Ulna . . . . .	2	13	3	Ext. Cuneiform . . . . .	6	2	2
Radius . . . . .	4	9	3	Metatarsal . . . . .	21	13	10
Scaphoid . . . . .	5	0	1	Phalanges . . . . .	23	23	28
Semilunar . . . . .	5	0	1	Malleus . . . . .	1	3	?
Cuneiform . . . . .	3	0	1	Incus . . . . .	2	0	?
Pisiform . . . . .	1	2	1	Stapes . . . . .	1	1	?
Trapezium . . . . .	4	3	1				

NERVES.

The two great systems are—(1) Cerebro-spinal, (2) Sympathetic.

1. CERE BRO-SPINAL SYSTEM.

1. The system of animal life, (sensation, motion, etc).



2. Occupies cranium and spinal canal.
3. Consists of (1) brain and cranial nerves, (2) spinal cord and spinal nerves.

2. SYMPATHETIC SYSTEM.

1. The system of organic life, (growth, nutrition, etc).

REMARK:—The distinction “organic” and “animal” is by no means complete.

2. It consists of a double chain of ganglia on each side of the spinal column from the base of the cranium to the coccyx; also ganglia in thorax, abdomen, head, face, etc.

N. B.—The nerves of either system anastomose with the other.

NERVOUS TISSUE.

Composed of 2 kinds of matter (1) gray, (2) white.

*The Gray.*

1. It is a fine connective tissue stroma imbedding in its meshes the gray vesicles or cells.

2. The *cells*.

1. Gray in color.
2. Invested in a delicate membrane.
3. Each contain a soft, albuminous nucleus.
4. Some have also a nucleolus.
5. Vary in size and shape.
6. Smallest in brain, largest in spinal cord.
7. Found on the *surface* of the brain, but in the *interior* of the spinal cord.
8. Their shape is generally oval.
9. Their shape *may* be irregular in outline with one, two, or more tails (processes) *i. e.*, *unipolar*, *bipolar*, or *multipolar*.
10. Function : *To generate nerve force.*

*The White.*

1. Where found :

1. In the interior of the brain,
2. On the surface of the spinal cord,
3. In nearly all *nerves* of both systems.
2. It consists of *three parts*:
  1. *The tubular membrane*, investing, protecting, and keeping the parts from injury.
  2. *The white substance* (of Schwann), inside of the tubular membrane, insulating the band axis, and together with the membrane, preventing diffusion of nerve force.
  3. *Band axis* (axis cylinder); (1) In the center of white substance, transparent and albuminous in character; (2) It is the *essential conducting agent*.

REMARK:—Where the white substance is wanting, they are denominated *non-medullated*.

#### THE STRUCTURE OF NERVES.

1. They are round or flattened cords,
2. The nerve filaments pursue an uninterrupted course from their origin to their termination.
3. They are surrounded by the *neurilemma* (sheath), which is fibro-elastic, in which the blood-vessels ramify, conveying *nutrition* to the nerve.
4. They pass into each other's sheaths.
5. *Motor* fibers, (central endings) enter brain and spinal cord, retaining axis cylinder only, and blend with the gray cells.
6. The *motor* (peripheral endings) form a plexus from which ultimate fibers issue and are distributed to the tissues.
7. The *white substance* of the nerve disappears, and the axis cylinder spreads out into a minute granular plate—the “motorial” end plate, as the motor nerve enters the muscular fiber; the tubular membrane blends with the myolemma. This is the form of connection between motor nerves and *voluntary muscle*.
8. In *involuntary muscle*, the motor nerves form at their endings, a plexus on the muscular fiber-cells, connecting with their nuclei.
9. The *sensitive nerves* end in 3 ways,—

1. In *tactile corpuscles*, (situated in the papillæ of the true skin) by approaching the corpuscles and winding 2 or 3 times around, the nerves end in loops (sense of touch).

2. In *end bulbs*, a coiled mass inclosed in very fine connecting tissue.

3. In *pacinian corpuscles*, the nerve fiber enters and ends in a knob in the central bulb, (not well understood).

10. *Efferent* or centripetal nerves pass outward to various organs, transmitting nervous impulses.

11. *Afferent* or centripetal, convey impulses to the nerve centers.

12. *Sensitive* nerves give rise to sensation.

13. *Vasomotor*, regulate the caliber of blood-vessels,

14. *Trophic*, influence nutrition.

15. *Secretory*, influence secretion.

16. *Inhibitory*, produce a restraining action.

17. *Motor* nerves may be paralyzed without affecting sensation, (introduce woodruff under the skin).

18. *Sensibility* may be abolished without destroying motion (employ anæsthetics).

19. *Motor* nerves conduct force at the rate of 120 feet per second.

20. *Sensory* nerves conduct force 190 feet per second.

21. *Nervous stimuli*—(1) mechanical, (2) thermal, (3) chemical, (4) electrical.

22. A *nerve* extends from a ganglia or center to some part of the body.

23. A *commissure*—from ganglia to ganglia.

#### GANGLIA.

1. Congregated, adjoining, communicating cells giving off fibers.

2. They may be regarded as independent centers.

3. They consist of fibrous investing membrane containing gray cells and gelatinous fibers.

4. *Situations*,—(1) on posterior roots of spinal nerves, (2) along sides of vertebral column, (3) on the cranial sensory nerves, (4) in the different viscera.

#### PLEXUS.

1. Branches of different *nerves* interlacing in the most intricate manner, in all directions.

2. Fibers are again given off to pursue an independent course.

#### SPINAL NERVES.

1. 31 in number.

2. Arising by 2 roots, *anterior* and *posterior*, uniting in the intervertebral foramen, and extending to the muscles, viscera, and skin.

*a. Anterior Roots. (Motor).*

1. Transmit impulses from center to periphery.

2. Irritation of these roots results in convulsive movements of the muscles.

3. Disease of these roots induces paralysis.

4. They arise from anterior columns of spinal cord.

*b. Posterior Roots. (Sensory).*

1. Transmit impressions from periphery to centers in spinal cord or brain promoting in the *first* instance motor impulses, in the *second*, conscious sensations.

2. Irritation of these roots causes the sensation of pain.

3. Sensation in a part may be lost by division or disease of these roots.

3. The 31 pairs enumerated thus: (1) cervical, eight; (2) dorsal, twelve; (3) lumbar, five; (4) sacral, five; (5) coccygeal, one.

1. *Cervical Plexus* gives off branches to (1) integuments, (2) parotid gland, (3) ear, (4) back of head.

2. *Brachial Plexus* to (1) shoulder joint, (2) pectoral muscles, (3) elbow and wrist, (4) hand and fingers, &c.

3. *Dorsal Nerves*. Pass to (1) muscles and integuments of back and loins, (2) lateral and forepart of thorax, (3) intercostals, (4) diaphragm, (5) they anastomose with the sympathetic.

4. *Sacral Nerves*. Pass to (1) pelvis, (2) thigh, (3) leg, (4) foot and toes.

#### SYMPATHETIC SYSTEM.

1. They communicate with all the *cerebral* nerves (except 3 of special sense, viz: olfactory, optic and auditory), and with all the *spinal* nerves.

2. Large plexuses are formed both in chest and abdomen in front of the vertebral column.

3. They ramify on the aorta, heart, venæ cavae, stomach, pulmonary vessels, subclavian, ribs, pharynx, vertebral column, pancreas, spleen, etc.

4. They follow the distribution of blood-vessels.

5. Characterized by their numerous ganglia, viz: (1) superior, (2) middle, (3) inferior cervical, (4) cardiac, (5) thoracic, (6) semilunar, (7) solar plexus (behind stomach), (8) renal, (9) inferior mesenteric, (10) lumbar, (11) sacral, (12) ganglion impar.

#### THE BRAIN AND ITS MEMBRANES.

##### THE BRAIN.

1. Average weight; male, 49½ ozs.; female, 44 ozs.

2. Weighs more than any of the lower animals except whale (5 lbs.) and elephant, (10 lbs.)

3. Maximum weight reached from 30 to 40 yrs. old.

4. Contained in the cranial cavity.

5. Composed of gray cells and white fibers.

6. The gray for the most part is on the surface; the white, within.

7. It is not only an originator or generator of nerve force, but a conductor of nervous impulses.



8. It has 4 divisions,—(1) Cerebrum, (2) Cerebellum, (3) Medulla oblongata, (4) Pons Varolii.

9. Enclosed in 3 distinct membranes,—(1) dura mater, (2) arachnoid, (3) pia mater.

#### CEREBRUM.

1. Average weight 3 lbs. (5 ozs. less in female).

2. The carotid and vertebral arteries supply it.

3. A decrease of blood to, a decrease of functional activity.

4. Consists of right and left hemisphere, divided by the longitudinal fissure from before backwards.

5. Connected with pons Varolii and medulla oblongata through crura cerebri, and with cerebellum through the superior peduncles.

6. *Gyri*,—rounded eminences (convolutions).

7. *Sulci*,—separates convolutions.

8. *Lobes*, five in number,—(1) frontal, separated from temporo-sphenoidal by fissure of Sylvius; (2) Island of Reil, in angle of rami of fissure of Sylvius; (3) Parietal, separated from frontal by fissure of Rolando; (4) Occipital, separated from parietal by parieto-occipital fissure; (5) Temporo-Sphenoidal, separated from frontal by fissure of Sylvius.

9. The hemispheres are the *centers* in which the phenomena of mind is manifested.

10. It is the *seat* of reason, intelligence, and will, registering impressions, and *reproducing them as ideas*.

#### CEREBELLUM.

1. Underneath back lobes of cerebrum.

2. In proportion to the cerebrum as 1 to  $8\frac{4}{7}$ .

3. Two hemispheres, and a central portion, the *Vermiform Process*.

4. Insensible and inexcitable.

5. Connects with *cerebrum* through superficial portion of *pons Varolii*, and with *spinal cord* through *restiform bodies*.

6. The *center* for co-ordination and equilibrium of muscular movement.

7. A vertical section gives an appearance called the *Arbor Vitæ*.

#### PONS VAROLII.

1. Unites with (1) *cerebrum*, (2) *cerebellum*, (3) *medulla oblongata*.

2. Its *transverse* fibers unite the hemispheres of the *cerebellum*.

3. Its *longitudinal* fibers, continuous with the *olivary bodies* and *anterior pyramids*.

4. It serves for the transmission of sensory and motor impulses to and from the *cerebrum*.

5. It seems to be the *center* of instinctive reflex-acts, and assists in automatic movements of station and progression. (See MEMBRANES).

#### MEDULLA OBLONGATA.

1. A bulb formed by expansion of upper part of *spinal cord*.

2. Divided in halves by anterior and posterior middle fissures, continuous with the cord.

3. Fibers of *anterior pyramids* cross (*decussation*) each other on their way to opposite sides of the brain.

4. Each half consists of 4 columns named from before backwards thus: (1) anterior pyramid, (2) lateral tract and olivary body, (3) restiform body, (4) posterior pyramid.

5. The *center* of mastication, respiration, deglutition, phonation, expression, and of the cardiac and vaso-motor nerves.

## MEMBRANES OF BRAIN.

### DURA MATER.

1. A firm, tough, white-fibrous-tissue.
2. Serves as internal periosteum to the skull bones.
3. Attached to edge of foramen magnum.
4. It supports the brain.
5. It forms the following:
  1. The *sinuses*, by separations in its layers, performing the offices of veins.
  2. *Falx cerebri*, between lobes of cerebrum.
  3. *Tentorium*, above cerebellum, below back part of cerebrum, separating them.
  4. *Falx cerebelli*, between lobes of cerebellum.

### ARACHNOID.

1. Very thin serous membrane.
2. Spread over surface of brain and spinal cord.
3. Between dura mater and pia mater.
4. It does not dip down into the sulci.
5. It consists of—
  1. *Parietal* layer, in contact with dura mater except where it forms the sub-dural space or cavity which contains fluid,
  2. The *visceral* layer, separated in many places from the pia mater, forming the sub-arachnoid space which contains the *cerebro-spinal fluid*.

PIA MATER.

1. Lines entire surface of brain and cord.
2. Connected to arachnoid at outer surface, except at the base and sulci.
3. Dips between the convolutions of the brain.
4. Enters ventricles by the great transverse fissure.
5. Composed of areolar tissue.
6. Gives off from its inner surface small blood-vessels penetrating the brain and cord.

SPINAL CORD.

1. From 16 to 18 inches long.
2. Has 3 membranes, same as brain.
3. Weighs  $1\frac{1}{2}$  ounces.
4. Gray matter inside, white outside.
5. Extends from atlas to second lumbar, ending in the *filum terminale* or cauda equina.
6. Has 8 columns, 4 on each side, continuous with those of the medulla oblongata.
7. The *ventricle of the cord*, (central canal) sometimes extends its entire length, being lined by the *ependyma* which also lines the ventricles of the brain being a transparent serous membrane.

FUNCTIONS OF THE NERVOUS SYSTEM.

It controls the processes of organic life; regulates nutrition, secretion, and temperature; governs all voluntary and involuntary muscular movement; sensation, mental and moral manifestations, motion, and language, and unites the organs and tissues of the body into an organic unit.

# CRANIAL NERVES.

NAME.	APPARENT ORIGIN.	PROPERTIES.	FUNCTION.	DISTRIBUTION.
1st pair, Olfactory	Anterior lobes of cerebrum	Convey special impressions of odorous substances	Governs sense of smell	Passes to ethmoid bone expands into olfactory bulb, thence to mucous membrane of nose.
2nd pair, Optic	Optic ganglion	Convey special impressions of light	Governs sense of sight	Passes through optic foramina, and distributed to the retina.
3rd pair, Motor Oculi Communis	Cerebral peduncles	Irritation causes contraction of pupil, l. n. ges crossed, inability to rotate the eye, dropping upper eyelid, etc.	Elevates upper eyelid; movements of iris; accommodation of eye but rectus and superior oblique muscles of eye by superior oblique muscles	Enters orbit through sphenoid fissure, thence to eye.
4th pair, Trochlears	ditto	Injury causes one image to appear above another, or eye turned downward and outward	Movements of eye by superior oblique muscles	Enters orbit through sphenoid fissure, thence to muscle.
5th pair, Trigeminal or Tri-facial	Pons varolii	Irritation, neuralgia of head and face	Most acute sense of any to head and face	From two roots, (the smaller passing through foramen ovale), consists of 3 branches, viz: Ophthalmic, superior and inferior maxillary.
6th pair, Motor Oculi Communis: Abducens	ditto	Irr. turns eyeball outwards, if paralyzed, cannot be turned outwards	To turn the eyeball outwards	Enters orbit through sphenoid fissure, thence to external rectus.
7th pair, Facial; Portis Dura	Medulla oblongata	Irritation produces convulsive movements of facial muscles	To give expression, also influencing taste, n. v. l. n. membrana tympani, etc.	Exit through stylo-mastoid foramen, thence to muscles of face.
8th pair, Auditory; Portis Molle	ditto	Convey impressions of sound	Governs hearing	Enter external auditory canal, thence to cochlea, vestibule and semi-circular canals.
9th pair, Glossopharyngeal	Cerebral peduncles and medulla oblongata	Irritation produces pain or contraction of muscles of pharynx and palate	Controls reflex movements of vomiting and swallowing; sensibility of pharynx	Passes through jugular foramen, and forwards to tongue and pharynx, tonsils, uvula, soft palate.
10th pair, Par Vagus Pneumogastric	Medulla oblongata	Exhibits both sensory and motor properties, at origin it is sensory.	Influences secretions of stomach, liver, etc., action of heart, respiration, voice, deglutition.	Passes through jugular foramen, thence to larynx, heart, stomach, lungs, intestines, liver, spleen, kidneys, etc.
11th pair, Spinal Accessory	ditto and spinal cord	Motor in beginning but from anastomosis it appears sensory	Excites heart's action, governs phonation by influencing organs in prolonged phonation	Enters cranium through foramen magnum, emerges through jugular foramen, receives and gives branches to other nerves.
12th pair, Sublingual; Hypo-glossal	Medulla oblongata	Motor inside, but sensory outside cran'um from anastomosis; produces differentiation and pronunciation	Governs all movements of tongue, influencing articulation, mastication and deglutition	Emerges through condyloid foramen, filaments to pneumogastric, sympathetic and others.

## MUSCLES.

1. They are bundles of reddish fibers.
2. They are connected with bones, cartilages, ligaments, and skin either by *tendons* or *aponeuroses*.
3. If connecting with cartilage or bone the fibers end bluntly on the *perichondrium* of the one and the *periosteum*, of the other.
4. If connecting with the skin they lie in a flattened layer under it, or connect with its areolar tissue.
5. The broad flattened muscles inclosing the cavities of the trunk are called its *parietes*.
6. They are called long, short, broad, &c., or penniform, bi-penniform; fusiform, radiated, &c., owing to their shape and position.
7. *Origin*, the central attachment; *insertion*, the point upon which it is directed.
8. *Tendons*, are either round or flat white fibrous tissue cords, with parallel fibrils, bound firmly together, with which the muscular fiber becomes blended.
9. *Aponeuroses*, white fibrous membranes, in structure resembling the tendons.
10. *Tendons* and *Aponeuroses* are always intermediately situated between the muscles and movable structures.
11. *Fasciæ* (a bandage) invest the softer and more delicate organs, and is either *superficial* or *deep*.
  1. The *superficial fasciæ* (fibro-areolar) is directly under the skin over nearly the entire body connecting it with the deep or aponeurotic fascia, and sub-adjacent parts, facilitating its movement, and



also retaining the warmth of the body owing to the *adipose tissue* being contained in its areolæ which is a bad conductor.

2. The *deep fascia* (aponeurotic) (1) consists of parallel tendinous fibers, connected by *reticular* (interwoven) fibers. (2) It binds down the muscles *collectively* and sheathes each one *individually*, and also the *vessels* and *nerves*. (3) It serves for the attachment of muscles (aponeurosis of attachment) and sheaths the entire limb, giving off septa separating the muscles and becoming attached to the *periosteum*, (aponeurosis of investment).

#### MUSCULAR TISSUE.

1. There are two kinds, viz :

1. Voluntary (striated), controlled by the will.
2. Involuntary (non-striated), as a rule, not controlled by the will.

#### STRIATED MUSCLES.

1. Consists of bundles of fibers surrounded by a web of areolar tissue called "*perimysium*."

2. Each bundle consists of smaller bundles, and these again of the primitive fasciculi (*fibrils*) enclosed in a tubular, elastic, transparent sheath called "*sarcolemma*."

3. These muscular fibers are distinguished by dark lines (striae) curving transversely (occasionally run longitudinally) around the fiber about  $\frac{1}{100000}$  of an inch apart.

4. Each primitive *fibril* is about  $\frac{1}{180000}$  of an inch in diameter.

5. The *fibrils* are composed of nucleated *cells* arranged in a *linear series*.

6. This form constitutes the *voluntary muscles*.

## NON-STRIATED MUSCLES.

1. The fibers form flattened bands, interlacing in all directions, the fibrils being composed of rod-shaped nucleated cells, and *without striae*.

2. The contraction is slower than in the *Striated*, and involves the entire muscle, *i. e.*, membranes composed of this tissue contract slowly, then the contracted part relaxes and is taken up by another part of the membrane; this action is strongly marked in the *vermicular motion*.

REMARK.—As muscles die they become stiff, the rigidity so characteristic of recent death is called "*Rigor Mortis*." The rigidity (stiffening) is mostly due to the solidifying of the contents of the sarcolemma. As rigidity ceases, putrefactive changes set in.

## GENERAL POINTS.

1. There are about 500 muscles.
2. They are all in pairs except 12.
3. *Extensors* pass over the back of joints.
4. *Flexors* pass in front of joints.
5. Law of contraction: They shall contract towards the center.
6. *Stimuli*.
  1. Mechanical, (touch).
  2. Chemical, (acids and alkalies).
  3. Electrical, (shocks).
  4. Vital, (Through the nervous system).
7. Blood vessels enter the perimysium and the fibers absorb their nutrition through the myolemma, (*endosmosis*).
8. USE: To give power of locomotion, ability to work, to communicate, etc., and by means of their contractile property the heart beats and circulation and respiration are carried on. They fill up cavities, give plumpness of appearance, and with the bones give support and power of resistance.

NAME.	ORIGIN.	INSERTION.	FUNCTION.
Occipito-frontalis	Outer $\frac{2}{3}$ sup. curved line of occiput and mastoid process	Frontal quadrilateral expansion to facial muscles	Chiefly, facial expression.
Orbicularis Palpebrarum	Sphincter of eye		To close the eyelids.
Levator Labii Superioris Alaque Nasi	Nasal process sup. maxillary bone	Cartilage of ala and upper lip	To elevate upper lip and dilate the nostril.
Orbicularis Oris	Sphincter of mouth		To close the mouth.
Masseter	Massal process sup. max. and two-thirds inner surface zygoma	Angle and ramus of the lower jaw	A muscle of mastication.
Temporal	Temporal fossa and fascia	Coronoid process inferior maxillary	To bring incisor teeth together; the "biting muscle."
Sterno-cleido-mastoid	Sternum and clavical	Mastoid process temporal bone	To depress, and also to rotate the head.
Longus Colli	Transverse processes of 3rd, 4th, and 5th C. V., and bodies of first 3 dorsal, and lower 3 cervical	Inner arch of atlas, transverse processes of the 2nd, 3rd, 4th, 5th and cervical	To flex the cervical vertebrae and partially rotate same.
Diaphragm	Ensiform cartilage, bodies of 11th and 12th vertebrae, on right side from 2nd to 4th and on left side from 2nd to 3rd and lower ribs	Central (cartiform) tendon (connected with deep cervical fascia)	Respiration and expulsion
Biceps	Long head, upper margin glenoid cavity. Short head, apex coracoid process	Tuberosity of radius and fascia of forearm	To supinate, and flex forearm.
Triceps	Outer and inner heads, shaft humerus. Long head, depression below glenoid cavity of scapula	Olecranon process of ulna	To extend the forearm.
Fastochiumenius	Two heads: One from each condyle of femur	Unites with tendo archillis to os calcis	To raise the body in walking or extend the foot.
Sartorius	Anter superior spine of ilium	Upper inner surface of tibia	To flex and cross the legs.

Suffice it is to say there are over 500 muscles, all in pairs one on each side of the body except 12; each having its antagonist, that is—as one relaxes the other contracts, (see flexors and extensors).

The *names of the muscles* have been derived (1) from their situation, as the Tibialis, (2) from their direction, as The Transversalis, (3) from their uses, as Flexor, (4) from their shape, as Deltoid, (5) from the number of their divisions, as Biceps, (6) from their points of attachment, as Sterno-cleido-mastoid.

### OPENINGS OF THE DIAPHRAGM.

1. *Oesophageal*, transmitting the œsophagus and pueumogastric nerves.

2. *Aortic*, transmitting aorta, vena azygos major, thoracic duct, and sometimes the left sympathetic nerve,

3. *Opening for the Vena Cava* is the highest.

4. The *Right Crus*, transmits the sympathetic and greater and lesser splanchnic nerves of right side.

5. The *Left Crus*, transmits the vena azygos minor and the greater and lesser splanchnic nerves of the left side.

### MOUTH.

1. Bounded above by the hard and soft palate.

2. Bounded below by the tongue and reflections of mucous membrane from it to the gums.

3. Bounded at the sides by the cheeks.

4. Anterior opening corresponds to the lips.

5. It communicates behind with the pharynx through the opening known as the *isthmus faucium*, which is bounded as follows :

1. Above, by the *soft palate* and uvula,

2. Below, by the tongue,

3. At the sides, by the tonsils and pillars of the palate.

6. The mouth is lined with squamous epithelium.

#### TEETH.

1. Number in adults 32, (permanent) in childhood, 20. (deciduous),
2. Their divisions are:—
  1. Incisors, eight,
  2. Canine, four,
  3. Bicuspids, eight,
  4. Molars, twelve.
3. *Wisdom* teeth, the two last Molars (appear late).
4. The division in childhood are:—
  1. Incisors, eight,
  2. Canine, four,
  3. Molars, eight.
5. Each tooth has—
  1. A crown, seen above the gums,
  2. A neck, between the crown and root,
  3. A root, fitted in the *alveolar process*, surrounded by periosteum that lines the alveola.
6. *Deciduous teeth*, begin to appear about 7th month, entirely appear about 24th month.
7. *Permanent teeth*, begin to appear about 7th year, entirely appear from 17th to 25th year.
8. The greatest number of teeth in jaws at any one time would be from 5 to 7 yrs. of age,—48 in number.
9. The hard substance is made up of dentine enamel and cement.
10. The *dentine* in the interior, inclosing the pulp containing blood-vessels and nerves.
11. *Use*: To grind the food.
12. They are *not* parts of the skeleton.

#### SALIVARY GLANDS.

1. *Parotid*,—in front and below outer ear, opening by Steno's duct opposite 2nd molar, upper jaw.

2. *Submaxillary*,—within and anterior to angle of lower jaw, opening by Wharton's duct at side of frænum linguæ.

3. *Sublingual*,—in contact with inner surface lower jaw, close to symphysis, opening by 8 to 20 ducts, *Ravinian*, on each side frænum linguæ.

4. *Function*: To secrete saliva (See FLUIDS).

#### TONGUE.

1. Made up of muscles, viz: (1) *Extrinsic*, attaching it to other bones, (2) *Intrinsic*, found within it; also mucous membrane, vessels, and nerves.

2. Attached to hyoid bone at base.

3. *Papillæ* of 3 kinds, (1) *maxima*, large forming row on back part like letter V inverted,

(2) *Media*, at apex and sides, round, deep red,

(3) *Minima*, cover  $\frac{2}{3}$  anterior part, small whitish.

4. *Trænum linguæ*,—(1) a distinct fold of mucous membrane, (2) beneath under surface of tongue.

5. *Sense of taste*,—principally in mucous membrane on upper surface and in the "*Taste buds*,"  $\frac{1}{800}$  inch long in the papillæ.

#### TONSILS.

1. Glanular; on each side of fauces.

2. Almond-shaped; marked by numerous crypts with follicles passing into substance of gland.

3. Corresponds to angle of lower jaw.

4. They seem to aid in *moistening food* passed between them.

#### PHARYNX.

1. A musculo-membraneous, conical-shaped bag.

2. Behind mouth, incomplete in front.

3. Attached above to occipital bone; below to œsophagus.

4. Has 7 *openings*,—two to Eustachian tubes, two to posterior nares, one to mouth, (isthmus fauces), one to œsophagus and one to larynx.



## ŒSOPHAGUS.

1. Membraneous muscular tube, 9 in. long.
2. From pharynx (5th cervical) to stomach (9th. dorsal).
3. 3 layers;—(1) muscular, (2) areolar, (3) mucous.
4. Narrowest part alimentary canal.
5. Œsophageal glands in subcutaneous tissue.
6. Conveys food to stomach.

## STOMACH.

1. The principal organ of digestion.
2. The most dilated part of the alimentary canal.
3. Serves for reduction and solution of food (*chymification*).
4. Situated in the left and part of the right hypochondriac and the epigastric regions.
5. Below the diaphragm and liver, above the transverse colon, beneath the ribs, and in contact with the pancreas and spleen.
6. Weighs about  $4\frac{1}{2}$  ounces.
7. It has two extremities, the splenic and pyloric.
8. The *cul de sac* is the part 2 or 3 inches to the left of the entrance of the Œsophagus.
9. It has 2 openings *cardiac* (into) and *pyloric* (out of).
10. Moved slightly downward and upward by breathing.
11. It has 3 coats, viz :
  1. *Muscular*, immediately beneath the serous and having 3 sets of fibers ; (1) longitudinal, (2) circular, (3) oblique.
  2. *Cellular* ( "vascular" ) connects mucous and muscular layers.
  3. *Mucous*, smooth, velvety, being in folds when the stomach is *empty*.

12. *Alveoli*, small hollows, from  $\frac{1}{100}$  to  $\frac{1}{350}$  of an inch in diameter.
13. Lined with columnar epithelium.
14. Capacity, about 5 pints.
15. The true *gastric* and mucous glands imbedded in the mucous coat.
16. The true *peptic glands*, mostly in cardiac end, yet may be found all over stomach.
17. The secretion of *gastric juice* is a reflex act of the nerves in response to the stimulus of food in the stomach.
18. Averages 5 inches deep by 13 inches long.
19. Kept in place by peritoneum.

## SMALL INTESTINE.

1. 20 feet long.
2. Held in place by peritoneum.
3. Has 3 parts,—(1) duodenum, (2) jejunum, (3) ileum.

## DUODENUM.

1. Length, 10 inches.
2. Shortest, widest, most fixed part of canal.
3. Like a horse-shoe around head of pancreas with convexity to the right, descends in front of right kidney, passes transversely across spine, ends in jejunum.
4. Bile and pancreatic juice poured into it where *chylification* takes place.

## JEJUNUM.

1. It lies in coils around the region of the umbilicus.
2. It is the upper  $\frac{2}{3}$  from the duodenum to the ileo-cæcal valve, no definite limit being between them.
3. The muscular fibers are longitudinal and circular.
4. *Valvulae conniventes*, the mucous layer thrown into folds.
5. *Villi*, minute vascular processes, number estimated for entire length of small intestine 4,000,000.

6. *Brunner's glands*, small flattened glandular bodies imbedded in the submucous areolar tissue.

7. *Crypts of Leiberkuhn*, minute tubular depressions scattered between the villi.

#### ILEUM.

1. Below the umbilical region.

2. Ending at *ileo-cæcal valve* (at entrance to colon).

3. *Solitary glands*, small, round, whitish, scattered throughout mucous membrane of small intestine, mostly in the ileum.

4. *Peyer's glands*, regarded as aggregations of solitary glands, in circular and oval patches, from 20 to 30 in number and from  $\frac{1}{2}$  to 4 inches long, on the side opposite the mesentery.

5. *Structure*, same as jejunum.

#### COLON.

1. Forms  $\frac{1}{5}$  of the canal.

2. Divided into (1) cæcum, (2) colon, (3) rectum.

3. Has no valvulae conniventes or villi.

4. It is sacculated and has small processes (the *appendices epiploïcal*) along its entire course.

5. Fibers of muscular coat longitudinal and circular. The longitudinal are collected into three bands which being shorter than the intestine throw it into folds.

#### CÆCUM. (Caput coli)

1. At right iliac fossa, behind abdominal wall.

2. The beginning of the colon.

3. Receives ileum at inner side.

4. Measures  $2\frac{1}{2}$  by  $2\frac{1}{2}$  inches.

5. Attached to its lower and back part is the *appendix vermiformis*, a worm shaped tube the size of a goose-quill in diameter, 3 to 6 inches long.

#### COLON.

1. Extends from cæcum to rectum.

2. Divided into (1) ascending, (2) transverse, (3) descending, (4) sigmoid flexure.

## SIGMOID FLEXURE.

1. From descending colon to rectum.
2. Curves like the letter S.
3. Held in place by sigmoid meso-colon.

## RECTUM.

1. From sigmoid flexure to terminus.
2. Cylindrical, but not sacculated.
3. From 6 to 8 inches long.

NOTES.—To follow *colon*, begin on right side (ascending) across (transverse) down left side (descending).

SUMMARY.—*Alimentary canal*, about 30 feet long and consists of—(1) Mouth, (2) Pharynx, (3) Oesophagus, (4) Stomach, (5) Small Intestine (Duodenum, Jejunum, Ileum), (6) Large Intestine (Cæcum, Colon, Sigmoid Flexure, Rectum).

## DIGESTION.

1. *Prehension*,—conveying food into mouth by hands and lips.

2. *Mastication*,—grinding same which becomes moistened and glued by the saliva.

3. *Deglutition*,—conveying it through isthmus fauces, and down the oesophagus into stomach.

4. *Gastric Digestion*,—changing it into chyme by action of gastric juice, &c., in stomach.

5. *Intestinal Digestion*,—the pancreatic juice and bile being poured into duodenum, changing it into chyle, which is absorbed by the lacteals.

6. Passing on through jejunum, ileum, colon, sigmoid flexure, absorption taking place more or less the entire length until,

7. *Egestion*, which act extrudes the indigestible substances from the body. (See FLUIDS).

The *changes* taking place in saccharine, albuminoid, and oleaginous principles of blood are,—(1) the conversion of starch begins with the saliva, (2) conversion of cane sugar and albuminoids, with gastric juice, (3) emulsifying of fats, with pancreatic juice and bile, (4) the intestinal juices harmonizing and completing all digestive operations.

## Absorption.

### ABSORPTION.

NAME.	ORIGIN.	COMPOSITION.	AM'T SECRE- TED IN 24 HOURS.	FUNCTI ON
LYMPH.	Transudes from capillary blood-vessels during process of diges- tion.	Water + proteids ( <i>i. e.</i> ) serum, albumen, fibrin, globulin) + Extratives (sugar, urea, cholestine) + fatty matter (a trace + salts.	3½ pounds empty into Thorax duct.	Eliminat'n of waste particles from the sys'm; on the other hand the introduction of new materi'l into the blood mostly from the alim'tary canal, but also from closed cavities of the body, respirat'y surface and skin
CHYLE.	Taken up from the alimentary canal principally by the lacteals.	Water + albumen + fibrin + extractives + fatty matter + salts.	Enters lymphatics and estimated as lymph.	

The agents of absorption are,—(1) veins, (2) lymphatics.

The *veins* absorb from the chyme as it passes along, (1) water, (2) albuminose, (3) glucose, (4) inorganic salts, conveying them *directly to the liver*.

*Lymphatics*; arise (1) in lymph spaces, (2) openings on surface serous membranes (not well understood). They originate at periphery and empty at base of neck by thoracic duct, which is a tube the size of a goose-quill, 20 inches long, from receptaculum chyli (2nd lumbar) to junction of internal jugular and left subclavian veins. The right lymphatic duct, very short, emptying at junction of *right* subclavian and jugular.

*Lacteals*; (1) originate within the villi, (2) pass through mesentery, (3) end in thoracic duct.

They absorb, (1) chyle, (2) water, (3) albuminose, (4) glucose, (5) salts.

## PERITONEUM.

1. The largest serous membrane in the body,—lines walls of abdomen, reflected almost entirely over the pelvic and abdominal viscera (except spleen, supra-renal capsules, and pancreas) and thus consisting of two layers, (1) parietal, (2) visceral.

2. There are some seventeen folds (“ligaments”) supporting different organs which to trace is almost, if not quite impossible.

3. The *Omenta* (Epiploa),—folds connecting *stomach* with other organs.

4. The *Mesenteries* (Mesos),—folds connecting *intestines* to the abdominal walls, (parieties of).

5. There are sacs filled with fat along upper part of rectum and particularly the transverse colon.

6. The *hepatic vessels* reach the liver *without perforating the membrane*.

7. There is nothing passing through the foramen of Winslow connecting the cavities of the general peritoneal cavity and the great omentum.

8. The divisions generally given are :—

1. *Mesentery* proper, containing lacteals, lymphatics, mesenteric arteries, veins, and nerves, and attached to lumbar vertebræ, and united to small intestines.

2. *Meso-Colon*,—connected to the colon.

3. *Meso-Rectum*,—connected to the rectum.



## MEMBRANES.

### 1. MUCOUS.

1. Continuous with the skin at the orifices of the body.

2. Lines entire gastro-intestinal tract.

3. The epithelium may be,—(1) columnar, (2) spheroidal, (3) ciliated.

4. The epithelium is supported by the *corium* being analogous to the derma of the skin, below which is the *fibro-vascular layer* with *basement membrane* intermediate.

5. The *fibro-vascular* layer contains (1) white and yellow fibrous tissue and vessels, (2) muscular fiber cells, (3) nerves, (4) lymphatics, (5) many glands imbedded in it, (6) villi and papillæ projecting out of it in many places.

### 2. SEROUS.

1. They form shut sacs.

2. Can be traced continuously around whole circumference.

3. Consists for the most part of a layer of epithelium, beneath which is connective or areolar tissue with basement membrane intermediate between the two.

### 3. SYNOVIAL.

1. Analogous in structure to the serous.

2. There are 3 kinds,—(1) *articular*, in all freely moving joints, (2) *bursal*, between surfaces moving upon each other, (3) *sheaths*, in osseo-fibrous canals through which tendons pass.

NAME.	ORIGIN.	COMPOSITION.	AMOUNT SECRETED IN 24 HOURS.	FUNCTION.
CEREBRO- SPINAL	Pia Mater	Water, Animal Matter and Salts	Very small	Prevents Friction and Con- cussion.
SALIVA	Salivary Glands	Water, Protein Matter, Inor- ganic Salts, Ptyalin	3½ pounds	Converts starch into grape sugar (glucose) and facilitates deglutition.
GASTRIC JUICE	Gastric Glands	Water, Pepsin, Inorganic Salts and Hydrochloric Acid	8 to 14 pounds	Converts Albumen into Al- buminose.
PANCREATIC JUICE	Pancreas	Water, Inorganic Salts and Albuminoid Substances	1½ pounds	Emulsifies fats, converts starch into glucose, and Albumen into Albuminose.
INTESTINAL JUICE	Follicles of Intestine	Water, Inorganic Matter and Salts	16 ounces	Assists digestion of Albumi- noids, and converts starch in- to glucose.
SYNOVIA	Synovial Membrane	Water, Albumen, Salts and Mucous	Undetermined	Lubricates the joints.
SEROUS	Serous Membrane	Water and Albumen	Undetermined	Prevents concussion and frie- tion by moistening.
MUCOUS	Mucous Membrane	Water, Albumen, Salts and debris of Cells secreting it	Undetermined	Protects and defends Mucous Membrane.
ENDOLYMPH	Inner layer of Membranous Labyrinth	Lipid and Serous	Undetermined	To aid in hearing.
TEARS	Lachrymal Glands	Water and Chloride of So- dium	Unknown	To soothe and cool during ex- cited brain.
SEBUM	Sebaceous Glands	Water, Salts, Fatty Globules and Epithelial Cells	Undetermined	To lubricate skin, to soften the hair.
MEIBOMIAN	Meibomian Glands in eye-lids	Fatty-like	Varies	To prevent adhesion of eye- lids.
CERUMEN	Glandule Ceruminosa of External Meatus	Waxy	Varies	Moistens membrane of tym- panum.

PERILYMPH	Membrane of inner surface of ossous labyrinth	Thin and limpid	Undetermined	To aid in hearing.
AQUEOUS	Iris, ciliary processes and inner surface cornea	Water and chloride of sodium	Undetermined	Refracting medium.
MILK	Mammary glands	Water, lactose, salts, fatty-matter, casein and serum albumen	Average 3 pints	In store for nutriment, perhaps.
ENDOLYMPH	Membranous labyrinth	Thin and limpid	Undetermined	To aid in hearing.
LIQVOR SANGVINUS	Formal basis of living bodies	Water, albumen (nutritious principle), paraglobin, fatty-matters, Febrinogen, organic matters and mineral salts	With the globules forms all the blood	Nutrition.
SWEAT	Sudoriparous glands	Water, urea, lactates, salts and fatty matters	23.62 ounces	Removes waste matters from the blood and regulates the temperature.
URINE	Kidneys	Water, urea, uric acid, hippuric acid, mucous, pigment, inorganic and organic salts, and nitrogen and carbonic acid gases	36.31 ounces	Eliminated from system.
BREATH	Lungs	Carbonic acid and vapor of water	13.4 ounces	The diffusion of gasses.
BILE	Liver	Water, fatty acids, cholesterine, GLYCOGEN	2 1/2 pounds	Promotes emulsification, and absorption of fats, prevents putrefactive changes, and stimulates peristaltic movement.

## PANCREAS.

1. Weighs  $3\frac{1}{2}$  ozs.
2. Average length 6 inches, breadth  $1\frac{1}{2}$  inches, thickness  $\frac{1}{2}$  inch.
3. Long and flat extending across the posterior wall of the abdomen, behind the stomach.
4. The right extremity bending from above downwards is called the *head*, embraced by concavity of duodenum.
5. The left extremity tapering, forms the *tail*.
6. The middle portion is called the *body*.
7. A lobular fold is on the anterior aspect which is sometimes detached from the rest, and is called the *lesser pancreas*. Its duct (ductus pancreaticus minor) opening either into the main duct, or separately into the duodenum an inch or more from the main duct.
8. The *Pancreatic duct*, (canal of Wirsung) extends from right to left through the substance of the gland, finally opening into the duodenum separately or in company with the *ductus communis choledochus*.
9. The *ductus communis choledochus* is formed by the union of the *cystic* (gall-bladder) and *hepatic* (liver) ducts; 3 inches long, size of goose-quill, and empties into duodenum. See FLUIDS.

## LIVER.

1. Largest gland in the body.
2. Average weight 4 lbs.
3. At right side below diaphragm, in contact with stomach, colon, duodenum, and right kidney.
4. Dimensions; transverse diameter 10 inches; antero-posterior diameter  $6\frac{1}{2}$  inches.
5. It has 5 *ligaments*,—the suspensory, two lateral and coronary attaching it to the diaphragm, and the round ligament ascending from the umbilicus.
6. It has 5 *fissures*,—the longitudinal, transverse (portal), fissure for the ductus venosus, fissure for the gall-bladder, fissure for the vena cava.

7. It has 5 lobes,—the right, the left, lobulus quadratus, lobulus Spigelii, and lobulus caudatus.

8. The right and left lobes are to each other as 6:1.

9. The liver is made up of lobules the  $\frac{1}{25}$  inch in diameter, which are composed of nucleated cells the  $\frac{1}{1000}$  inch in diameter which are the true hepatic cells.

10. The hepatic ducts (bile capillaries) originate in the lobules.

11. The bile channels are  $\frac{1}{200}$  inch in diameter and empty into the interlobular ducts.

12. THE GALL BLADDER is (1) on under surface of right lobe, (2) pear-shaped, (3) length 4 inches, (4) holds about  $1\frac{1}{2}$  fluid ounces of bile.

13. The liver is appended to the alimentary canal, and performs the triple office of (1) excretion of bile, (2) elaboration of blood, (3) secretion of glycogen.

1. Bile, does not per exist in the blood, but is formed in the hepatic cells from both venous and arterial blood, and stored up during the intervals of digestion in the gall-bladder from which it is discharged as food passes into the alimentary canal (See FLUIDS).

2. Elaboration of Blood: It also has the property of changing products of digestion transversing its substance, till they readily assimilate with the blood and are converted into tissues and solids.

3. Glycogen: a sugar-forming substance formed, it would seem, denovo in the cells from materials derived from the food, consisting mostly of glucose into which it is transformed on being carried from the liver, by the agency of a ferment.

14. The bile empties through the ductus communis choledochus, which see, (point 8, Pancreas).

## KIDNEYS.

1. On each side of spinal column.

2. Opposite the two upper lumbar vertebrae.

3. Bean-shaped, and brownish red in color.
4. Length  $4\frac{1}{2}$  inches, breadth 2 inches, thickness 1 inch.
5. The right a little lower than the left.
6. Composed of two substances,—(1) medullary, (2) cortical.

(1) *Medullary.*

1. The internal portion.
2. Consists of about 15 pyramids (Malpighian) with apices towards *pelvis*, with the *papillæ* having a slight depression, the *foveola* on the apex.
3. *Infundibulum*,—a membranous cup surrounding each papilla, 4 or 5 of these uniting to form the *calyx*, 3 or 4 calyces uniting to form a common trunk the *pelvis* from which proceeds the excretory tube of the kidney.
7. The *Malpighian bodies*,—little flask-like extremities of the convoluted tubes of the *cortical* substance,  $\frac{1}{300}$  inch in diameter.

8. The *Cortical substance*, is the external part about  $\frac{1}{6}$  inch in diameter containing immense numbers of *tubules* extending in every possible direction constituting the *secretory tubes*, the excretion *finally* passing out by way of the *ureters* (18 inches long) and bladder.

## THE SPLEEN.

1. It averages 5 by 3 by 2 inches.
2. Weighs from 8 to 10 ounces.
3. It is spongy, soft, and vascular.
4. It is connected to the cardiac end of the stomach by the gastro-splenic omentum.
5. *The Suspensory Ligament*,—a fold of peritoneum attaches it to the diaphragm at its upper extremity.
6. *Hilum*, a vertical fissure on concave surface pierced by vessels, nerves, and lymphatics.



7. It has two coats (1) External serous, (2) Internal fibrous elastic.

1. External.—peritoneum, investing almost the entire organ.

2. Fibrous Elastic.—forms frame-work of spleen investing the exterior and reflected in upon the vessels in the form of sheaths.

8. *Splenic Pulpa* or substance,—surrounds the Malpighian corpuscles in the interspaces of the areolar frame-work.

9. *Malpighian corpuscles*—expansions of outer coat of the small arteries being about  $\frac{1}{60}$  inch in diameter.

10. It has no excretory duct.

11. Its *function* is not well understood.

## EYE.

1. The *Tunics* (coverings) are three, viz.

1. Sclerotica and Cornea,
2. Choroid, Iris and Ciliary Processes,
3. Retina.

2. The *Refracting Media* are three, viz ;

1. Aqueous Humor,
2. Crystalline Lens and capsule,
3. Vitreous humor.

## SCLEROTIC.

1. Dense, hard, forming posterior  $\frac{5}{6}$  of globe,

2. Maintains form of the globe,

3. Thicker behind ( $\frac{1}{25}$  inch) than in front, ( $\frac{1}{60}$  inch)

4. Two *surfaces*,

1. External, smooth, white, partly covered by conjunctiva into which Recti and Oblique muscles are inserted.

2. Internal, brown, with grooves for ciliary nerves, connected with outer surface of choroid by fine cellular tissue (*lamina fusca*) contains orifices for the transmission of nerve filaments the most

important being that transmitting the *arteria centralis retina* to interior of eye-ball.

5. In front, joins with cornea by direct continuity of tissue.

6. Overlaps cornea a little more on outer than inner surface.

7. Few vessels, small capillaries, nerves doubtful.

### CORNEA.

1. Forms anterior  $\frac{1}{6}$  of the globe.

2. Projecting and transparent, being  $\frac{1}{28}$  inch thick at center.

3. It is set into the sclerotic as a watch crystal into its case.

4. Not quite circular, broadest transversely.

5. Degree of curvature differs in different persons and at different times in the same person.

6. Posterior surface perfectly circular in outline.

7. Has 5 layers, viz :

1. *fibrous* central structure, "cornea proper,"  $\frac{1}{25}$  inch thick.

2. The anterior *elastic* lamina, covered by the conjunctiva.

3. The posterior *elastic* lamina,  $\frac{1}{2000}$  inch thick covered by lining membrane of anterior chamber.

4. *Conjunctival* Epithelium,  $\frac{1}{800}$  inch thick covering front of the anterior elastic lamina.

5. *Epithelial* lining of aqueous chamber.

8. The elastic laminae preserve the curvature.

9. Capillaries end in loops.

10. Nerves, derived from ciliary nerves and ramify in the laminated surface.

### CHOROID.

1. Invests posterior  $\frac{5}{6}$  of the globe.

2. It is from  $\frac{1}{300}$  to  $\frac{1}{150}$  inch thick.

3. Extends forward a little in front of the equator, ending at the ciliary ligament.

4. Dark brown in color.

5. Pierced behind by the optic nerve.

6. Connected externally with inner surface of sclerotic by cellular web, the *membrana fusca*.
7. The internal surface is in contact with the retina.
8. It has 3 layers, viz :
  1. *External*,—mostly formed of converging veins, forming 4 or 5 equidistant trunks, piercing sclerotic half way between the entrance of the optic nerve and edge of cornea.
  2. *Middle*, fine plexus of short ciliary vessels, (tunica Ruyschiana)
  3. *Internal*, (Pigmentary,) delicate membrane of nucleated cells loaded with pigment granules.
9. It contains no pigment in Albinos.

## CILIARY PROCESSES.

1. Behind the iris, around margin of lens.
2. They are about  $\frac{1}{10}$  inch long.
3. In number from 60 to 80 arranged in a circle.
4. They lay side by side and are of large and small size.
5. Their direction is longitudinal forming a curtain-like expansion behind the iris.
6. Attached to ciliary ligament, *continuous* with middle and inner layers of choroid with opposite margin free, resting on the circumference of the lens.

## IRIS.

1. A thin, circular, contractile curtain suspended in the aqueous humor behind the cornea and in front of the lens.
2. It is about  $\frac{1}{6}$  inch in width, and  $\frac{1}{100}$  inch in thickness.
3. Perforated by the pupil which is from  $\frac{1}{12}$  to  $\frac{1}{4}$  inch in diameter.
4. The sphincter muscular fibers *contract*, and the radiating fibers *expand*, the pupil.
5. The inner edge of iris forms the pupil, the outer edge connects with the choroid.

6. The *color* varies owing to difference in color of the pigment cells.

#### RETINA.

1. Images are received upon its surface.
2. It is about  $\frac{1}{75}$  inch in thickness.
3. Ends nearly as far forward as the ciliary ligament in a jagged margin, the *ora serrata*.
4. It is a delicate transparent membrane.
5. In the posterior part at a point corresponding to the axis of vision, is the *yellow spot* of Sæmmering, having a central depression, the *fovea centralis*.
6. The *optic nerve* enters about  $\frac{1}{10}$  inch to the inner side of the yellow spot (*limbus luteus*) spreading out, aiding to form the retina.
7. The *arteria centralis* pierces the optic nerve.
8. The retina consists of 3 layers, viz :
  1. *External*, or columnar.
  2. *Middle*, or glanular.
  3. *Internal*, or nervous. (Gray)

According to others, 10 layers, viz : (1) *membrana limitans interna*, (2) fibers of optic nerve, (3) layers of ganglionic corpuscles, (4) molecular layer, (5) internal glanular layer, (6) molecular layer, (7) external glanular layer, (8) *membrana limitans externa*, (9) layer of rods and cones, (10) layer of pigment cells.

9. The estimated number of optic nerve fibers are 800,000; and for each fiber there are 7 cones, 7 pigment cells, and 100 rods.

10. The points of rods and cones point *from* the entering light, dipping into the pigment layer.

11. The rods, cones and pigment layer intermediate the change of ethereal vibrations into nervous force, which is fashioned into sensations of light, form and color in the occipital lobe.

AQUEOUS HUMOR.

1. Fills both anterior and posterior chambers.
2. Weight 4 or 5 grains.
3. *Anterior Chamber*, between the cornea in front, and the iris and ciliary ligaments behind.
4. *Posterior Chamber* (denied by many authorities) is between the iris in front, and capsule of lens, ciliary ligament and processes behind.

VITREOUS HUMOR, (Hyaloid Body).

1. Fills cavity of retina.
2. Inclosed in the hyaloid membrane.
3. Albuminous, transparent, jelly-like.
4. Hollowed in front receiving the lens and its capsule.

CRYSTALLINE LENS AND ITS CAPSULE.

1. Lens enclosed in its capsule, which is transparent, elastic and  $\frac{1}{200}$  inch in thickness.
2. Behind pupil, in front of vitreous body.
3. Surrounded by ciliary processes.

LENS.

1. Transparent *double-convex* lens.
2. *Composed* of water, cholesterine, soluble and insoluble albuminous matter.
3. Weight from 4 to  $4\frac{1}{2}$  grains.
4. Transverse diameter,  $\frac{1}{3}$  inch; antero-posterior diameter  $\frac{1}{4}$  inch.
5. It has no vessels or nerves, receiving its nutrition by *imbibition*.
6. It consists of concentric layers, the outer being soft, the next firmer; the inner hard nucleus.
7. It refracts and concentrates the ray of light at a given point posterior to it, and, if accurately focused on the retina a *correct* perception of images of external objects is the result.

8. It is held in position between the layers of the *hyaloid membrane* which having separated pass in front and behind it, being called the *suspensory ligament*; the space formed by its separation is the *Canal of Petit*.

#### THE EYE BALL.

1. *Diameters*,—Antero-posterior  $\frac{95}{100}$  inch,—Transverse,  $\frac{92}{100}$  inch,—Vertical,  $\frac{90}{100}$  inch (adult).

2. *Anterior Pole*,—center of the cornea,

3. *Posterior Pole*,—center of the fundus,

4. *Axis*,—imaginary line connecting the poles,

5. *Visual Axis*,—imaginary line from the yellow spot to the object cutting the axis at an angle of from  $3^{\circ}$  to  $7^{\circ}$ , the *Visual Angle*.

6. *Equator*, an imaginary line passing round the globe dividing it into anterior and posterior hemispheres.

7. *Meridian Planes*,—coincide with the axis.

8. The eye ball *rests* on a cushion of fat and connective tissue, *retained* by muscles, conjunctiva, &c.

#### 1. WHAT IS IT TO SEE?

The *course* a ray of light takes is as follows: It passes through (1) cornea, (2) lens, (3) vitreous humor, (4) layers of the retina, (5) being arrested by the pigment layer of the choroid, here exciting some physical or chemical change in the layer rods and cones, whence (6) it is transmitted to the fibers of the optic nerve, and thence (7) to the occipital lobes where (8) it is perceived as a *sensation of light*.

2. The *eye structures* are supplied with blood by the ciliary arteries piercing its posterior part around the optic nerve.

3. The *conjunctiva* is the mucous membrane of the eye.

4. *Eye-lids* shade the eye and protect it from injury.

See MUSCLES.



5. *Lachrymal Glands*,—at upper and outer part of the orbital cavity opening by 6 or 8 ducts at the outer part of the upper eye-lid.

## NASAL FOSSAE.

1. Two irregular cavities separated by the *vomer*, perpendicular plate of ethmoid bone and the triangular cartilage.

2. The cavities open anteriorly (anterior nares) and posteriorly, (posterior nares).

3. Lined by mucous membrane with ciliated epithelium.

4. The upper  $\frac{1}{3}$  of the fossæ is the only part capable of receiving odorous impressions.

5. *Nerves* distributed between the epithelial cells of the olfactory mucous membrane.

6. The *olfactory bulbs* are the *centers* perceiving the sensations, and are formed by an expansion of the 1st pair of nerves.

## THE EAR.

1. The organ of hearing.

2. Consists of—

1. *External ear*, including the *pinna* and *external meatus*.

2. *Middle ear*, including the *tympanum* and its appendages.

3. *Internal ear*, including the *vestibule*, *semi-circular canals* and *cochlea*.

### PINNA.

1. A fibro-cartilaginous plate covered by integument.

2. Collects the sound waves, transmitting them to the *membrana tympani*.

3. *Helix*, forms the semi-circular outline or border.

4. *Anti-helix*, below the helix inclosing a fossa (depression).

5. *Tragus*, an eminence anterior and inferior to the external meatus.

6. *Lobule*, pendulous body underneath the anti-tragus.

7. *Concha*, the deep, conoidal cavity leading to the meatus.

8. *Fossa of the helix*, a groove between the helix and anti-helix.

#### EXTERNAL MEATUS.

1. A curved canal leading from the concha to the membrana tympani.

2. Outer half cartilaginous, inner half osseous.

3. Length about  $1\frac{1}{4}$  inches.

4. Lined by skin underneath which are glands called *glandulae ceruminosae*, secreting the *cerumen*, or "ear-wax."

#### MEMBRANA TYMPANI.

1. Separates the external and middle ears.

2. Circular, at an angle of  $45^\circ$  and consists of 3 layers,—(1) external, (cuticular), (2) internal, (mucous), (3) middle, (fibrous).

3. At inner aspect, attached to the handle of the malleus.

4. It receives and transmits the sound-waves to the chain of bones.

5. When relaxed it vibrates farther appreciating a *low tone*.

6. When tense it vibrates less forcibly appreciating a *high tone*.

#### MIDDLE EAR.

1. Consists of the cavity of the tympanum, and small bones and their muscles.

2. It is an irregular space closed externally by the membrana tympani, and internally by a second membrana tympani separating it from the labyrinth.

3. Length  $\frac{1}{2}$  inch.
4. Lined with mucous membrane,
5. Communicates with the mastoid cells, and by the Eustachian tube with the pharynx.
6. Contains 3 connected bones extending across its cavity, viz :

1. *The Malleus* (Hammer), having a head, (articulating with Incus) neck and handle (articulating with the *membrana tympani*).

2. *The Incus* (anvil), with a cup-like cavity for the head of the malleus, a short process lying in the mastoid cells, and a long process having attached to its extremity a small process of bone, the *os orbiculare* by some considered to be a distinct bone.

3. *The Stapes* (stirrup), attached by its head to the orbicular process externally and to the edges of the foramen ovale internally.

7. The chain of bones is surrounded by air, and transmit the waves of sound across the tympanum to the internal ear (labyrinth).

#### EUSTACHIAN TUBE.

1. Partly bony, partly cartilaginous.
2. About  $1\frac{1}{2}$  inches long, lined with mucous membrane having ciliated epithelium.
3. Extends from middle ear to pharynx permitting the passage of air to the middle ear, *equalizing the pressure*.

#### INTERNAL EAR.

1. In the petrous portion of the temporal bone.
2. Consists of an *osseous* and a *membranous* portion.

#### I.

#### OSSEOUS LABYRINTH.

Divided into 3 parts,—(1) the vestibule, (2) the semi-circular canals, (3) the cochlea.

#### THE VESTIBULE.

1. Behind the cochlea, and in front of the semi-circular canals.

2. Oval cavity,  $\frac{1}{5}$  of an inch in diameter, containing watery fluid.

3. Communicates with middle ear by foramen ovale.

4. Has several openings, among which may be mentioned (1) fenestra ovalis, on outer wall, (2) aqueductus vestibuli, on inner wall, (3) the *five openings* of the semi-circular canals, on posterior walls.

## II. THE SEMI-CIRCULAR CANALS.

1. Three in number, viz : the superior vertical, the inferior vertical, and the horizontal, each opening into the vestibule by two openings, except the two vertical, which open at *one* extremity by a common opening.

2. Each semi-circular canal  $\frac{1}{20}$  is of an inch in diameter, presenting a dilation at one end called the *ampulla* about  $\frac{1}{10}$  of an inch in diameter.

## III. COCHLEA.

1. A tapering canal,  $1\frac{1}{2}$  inches long.

2. Turns  $2\frac{1}{2}$  times round a central pillar, the *modiolus*.

3. Divided into two passages, the *scala tympani* and *scala vestibule* by a thin plate of bone projecting  $\frac{2}{3}$  across the canal.

4. The *Perilymph* fills the interior of the osseous labyrinth, cochlea, semi-circular canals and vestibule.

## I. MEMBRANOUS LABYRINTHS.

1. Smaller, and corresponds in shape to the osseous labyrinth.

2. The *utricle* and *sacculle* (little sacs), situated in the vestibular part, (1) the *utricle* communicating with the semi-circular canals about the same way that the semi-circular canals and vestibule do in the osseous labyrinth, and (2) the *sacculle* with the membranous cochlea, which tapers to a point and situated next to the outer wall of the osseous cochlea.

3. OTOLITHS, OR EAR-STONES,—a powder, made up of crystals of carbonate of lime,  $\frac{1}{3000}$  to  $\frac{1}{2000}$  of an inch in diameter, being held together by a mucoid substance, and found in the utricle and saccule, in the membranous labyrinth.

4. The *Endolymph* fills the interior of the membranous labyrinth, cochlea, canals, utricle and saccule.

#### RODS OF CORTI, (Organ of Corti).

1. It is situated in the membranous cochlea.
2. Of cartilaginous consistence.
3. An inner and an outer set arranged obliquely, their ends supporting each other.
4. The inner *hair-cells* are internal to the *inner* rods, the outer *hair-cells* on the outer side of the *external* row.
5. The estimated number of rods in the internal row is 3500; in the external row, 5200.

#### FUNCTIONS.

1. The COCHLEA is thought to possess the power of appreciating *pitch* and *shades* of musical tones.
2. The SEMI-CIRCULAR CANALS seem to aid in maintaining the *equilibrium* of the body, as well as to assist in hearing, since their loss is attended with a loss of power to maintain the equilibrium.

#### 3. WHAT IS IT TO HEAR?

The pinna and external meatus gather the waves of sound, conveying them to the tympani, which, aided by its muscles, (tensor and laxator), receives the waves of either low or high pitch, sends them by its vibrations across the middle ear through the chain of bones to the foramen ovale, and by the air of the tympanum to the second membrana tympani, which closes the foramen rotunda where the labyrinth receives the vibrations, which are then transmitted through the perilymph, membranous labyrinth and endolymph; it is thence taken up by filaments of the auditory nerve, and conveyed to the brain, where it is recognized as a sensation of sound.

## SKIN.

1. Its *main divisions* are,—(1) Epidermis or Cuticle, with its sub-divisions the superficial *epithelial* layers, and the rete mucosum or *pigmentary* layers, (2) *Derma*, or Cutis Vera (true skin) with its sub-divisions, the *papillary* layer below and separated from the rete mucosum by the basement membrane, and the *corium*, the deepest part.

2. In the sub-cutaneous cellular tissue are found,—(1) sebaceous glands, (2) sweat glands, (3) fat cells, (4) hair roots.

3. The derma and epidermis are both perforated by hair-follicles, ducts of sweat glands, and sometimes ducts of sebaceous glands.

4. *Number of sweat glands*,—from 417 to 2800 per square inch giving a sum total for the whole body of about two and a half millions, being equal to about 8 square inches of evaporating surface.

5. The skin is from  $\frac{1}{8}$  of an inch to  $\frac{1}{100}$  of an inch in thickness.

6. It is lubricated by *sebum* from the sebaceous glands.

7. *Carbonic Acid* is exhaled from the skin in amount equal to about the  $\frac{1}{200}$  of that from the lungs. See FLUIDS.

8. *Perspiration*,—(1) *Sensible*, when evaporation is not rapid enough to carry it away as in vigorous exercise, &c. (2) *Insensible*,—where it takes place gradually, passing off by evaporation as fast as formed.

9. Total amount of perspiration excreted daily, about 2 lbs.

10. FUNCTIONS OF THE SKIN,—(1) A protective covering, (2) An eliminating organ, (3) An organ of sensibility.

## HAIR.

1. A modified form of epidermis.

2. *Color*, from the deposition of pigment matter.



3. Softened by the sebum.

4. Each hair consists of (1) The *Root* lodged in an involution of the epidermis called the *Hair follicle*, in the bottom of which is a papillary projection which gives it material for its growth. (2) The *Shaft*, the projecting portion with medulla in the center, next to this a fibrous part, and externally a layer of imbricated cells; or thus: It consists of a fibrous tissue with thin flat scales externally and pigmentary cells internally. (3) *Point*, consists of the flat scales externally and the fibrous part without medulla in the center.

5. FUNCTIONS: (1) Prevents foreign bodies from entering the ears, nose, lungs, etc., (2) Retains the heat of the body, (3) Protects from cold and sun.

## NAILS.

1. They are flat, horny structures,
2. Formed from the pavement epithelium,
3. Each nail is fastened into a fold of the integument,
4. The *matrix* lies immediately below the nail,
5. The *lunula* is that white crescent-shaped part next to its root caused by a diminution in the number of underlying papillæ.

## PLEURÆ.

1. A delicate serous membrane enclosing each lung as far as its root (*visceral layer*) and then reflected upon the inner surface of the thorax (*parietal layer*).
2. The *Plural cavity* is the interspace between the two layers.
3. Each pleura is a shut sac, occupying one-half of the thorax, and are perfectly separate.
4. Each pleura envelopes a lung, meeting only in one point in front.

5. The interspace *between* them containing the remaining viscera of the thorax is the *mediastinum*.

6. Each pleural cavity contains a *serous fluid* moistening and preventing friction.

## ABRIDGMENT OF THE SKULL BONES.

The following is merely a reminder to the student of Anatomy in his examination of the skull bones :

### 1. OCCIPITAL.

1. Posterior and inferior surface of cranium.

2. Posterior surface convex with protuberance at center.

3. The *crest*, from protuberance to foramen magnum to which is attached the ligamentum nuchæ.

4. The *foramen magnum* transmits (1) medulla oblongata and its membranes, (2) the vertebral arteries, (3) the spinal accessory nerves.

5. *Locate*: Condyles, basilar and jugular processes, pharyngeal spine, anterior and posterior condyloid foramina, fossæ cerebri et cerebelli, torcula protuberance; grooves for occipital, lateral, inferior petrosal, superior longitudinal sinus and medulla, jugular fossæ.

### 2. PARIETAL.

1. Upper and sides of cranium.

2. On inner surface are (1) convolutions of brain, (2) Pacchionian bodies, (3) meningeal arteries (4) superior longitudinal sinus.

3. *Locate*: Eminence, foramen, temporal ridge, middle meningeal groove, Pacchionian depressions, lateral and longitudinal sinus.

### 3. FRONTAL.

1. Upper and anterior part of skull.

2. Frontal sinuses separate its two tables on either side of the nasal process.

3. *Locate*: Superciliary ridge, eminence, external and internal angular processes, temporal ridges and fossa, supra orbital notches and arches, nasal spine and eminence, orbital plates, lachrymal fossa, ethmoid notch, meningeal grooves, pulley depression, anterior ethmoid foramina, frontal and superior longitudinal sinus and Pacchionian depressions.

4.

TEMPORAL.

1. Lateral, middle and interior part of skull.

2. Divided into (1) squamous, (2) mastoid, (3) petrous.

3. *Locate*: Zygoma, articular eminence, auditory, mastoid, styloid, and vaginal processes, glenoid fossa, Glasserian fissure, mastoid foramen, superior and inferior petrosal and lateral sinus, aqueductus vestibuli, meatus auditorius internus, hiatus Fallopii, carotid canal, depression Casserian ganglion, opening for smaller petrosal nerve, and Jacobson's and Arnold's, aqueductus cochlea, auricular fissure, stylo-mastoid foramen, jugular fossa, canal for Eustachian tube, and tensor tympani.

5.

SPHENOID.

1. In the base of the skull.

2. Body in center, wings extend out on each side, and the pterygoid processes project from it below.

3. Body hollowed out in interior, presenting a mere shell.

4. Articulates with all bones of the cranium and five of the face.

5. *Locate*: Sella turcica; anterior, middle and posterior clinoid processes, olivary process, optic groove, ethmoid spine, cavernous groove; spinous, hamular, vaginal, external and internal pterygoid processes; the opticum, rotundum, lacerum anterior, Versalii, spinosum and ovale foramina; rostrum, pterygoid ridge and notch, scaphoid, pterygoid, temporal and zygomatic fossæ, pterygopalatine and Vidian canals.

6.

## ETHMOID.

1. Cubical form, between the orbits, at the root of the nose, light and spongy.

2. Helps form cavities of orbits and nose.

3. Ethmoid cells, 10 or 12 in number.

4. *Locate*: Crista galli, infundibulum, os planum, unciform processes, superior meatus, anterior and posterior cells and olfactory foramina.

## HYGIENE.

Surely, if it be an important matter to know how to relieve pain, to cure diseases, and to restore health when lost, it is *vastly* more important to be able to avoid pain and disease and preserve that bodily health without which all other sublunary favors are bestowed in vain. Many a heedless youth and blooming fair one, for the merest momentary gratifications, are urging their way with rapid strides to premature old age, or an untimely grave.

1. *Deeply possess* your mind with the vast importance of a good judgment and the inestimable advantage of right reasoning.

2. Consider the *weaknesses, frailties* and *mistakes* of human nature in general which arise from the very constitution of a soul united to an animal body, and by this subjected to many inconveniences.

3. Watch against the *pride* of your own reason. Those who trust to their own understanding entirely are pronounced fools in the word of God. Remember the highest degree of human wisdom consists in regulating our appetites and passions, so as to avoid *all extremes*. It is that which chiefly entitles us to the character of rational beings. The slaves of appetite will ever be the disgrace of human nature. It is in vain to attempt giving precise rules for the quanti-

ty or quality of food to be eaten by others. Every one knows when he has eaten enough and may avoid *excess* if he will. Simplicity of diet is the perfection of the art; and no animal but *man* misapprehends its rules. He alone feasts on the luxuries of a foreign soil, and finds in the dainties of earth the elements of his own destruction.

4. *Clothing* is too often perverted from its proper use, and made an object of pride and show; the fashions are continually changing without much regard to either health, comfort, or convenience. It would be a thankless task to point out the hurtful effects of the present fashionable mode of dress.

5. "*Cleanliness* is next to godliness." Few virtues are more important to society than general cleanliness. The continual discharge from our bodies by perspiration renders a frequent change of apparel necessary. When this matter which should be carried off by perspiration is retained in the body or re-absorbed by the skin from dirty clothing it must occasion disease. The clothes of the sick and the sheets upon which they lie should be changed as often as convenient without too much exposure and fatigue, being careful that they are entirely free from dampness.

6. *Cold water* preserves the freshness of the skin, preventing wrinkles, etc. A person who bathes in cold water freely is much less liable to take cold, lung troubles, sore-throat or dyspepsia; and lassitude, despondency, and indolence will find no lodging place.

7. *Sleep* is as necessary as any of the means to preserve health. We who will subvert the established order of high heaven by changing night into day and vice versa, will suffer the penalty of the violation.

We shall close our introduction to health with a few words to the

#### STUDIOUS.

This being the most intelligent class of mankind, we might reasonably expect that they, of all others, would be best qualified to understand and obey the



laws of our physical organization, and that they would be the first to adopt a rigid mode of discipline for the preservation of body as well as the cultivation of the mind.

Our constitutions are no more adapted to continual study than they are to continual physical labor and that student who thinks the *necessary* time spent in exercise and amusement is lost from study has not learned the first principles of acquiring knowledge. *One* hour's efficient study, when the mind is clear and untrammelled, and the body invigorated is worth *three* or more spent in dull musing when the mind is clouded and the wheels of life "wading in backed water." Let the student engage immediately after a full meal in hard study; the energies of the system being diverted from the stomach and concentrated upon the brain the food is imperfectly digested, and if the imposition is kept up, "heart-burn," head-ache, languor, shattered nerves, etc., will be the legitimate consequences.

"Never engage in study for at least thirty minutes after a full meal." Pointing you to the fact that ignorance and intemperance is the root of all pain, and on the other hand, that light, truth and knowledge is the germ of life and happiness, we implore you *to know* and *to improve* upon those God-given powers placed within you, we point you to other pages in this little manual.

#### THE BRAIN.

1. Avoid blows or undue pressure lest the hemispheres become disorganized causing a disturbance or entire suspension of mental activity.

2. TAKE TIME TO SLEEP. During the waking state the brain undergoes a certain amount of waste as a result of the exercise of its important functions, the activity becomes enfeebled at which time there is an accumulation of waste and consequently a diminished molecular activity which is insufficient to dominate



the medulla oblongata and spinal cord which act the more vigorously and through the action of the vaso-motor nerves lessen the caliber of the cerebral blood-vessels thus *diminishing the quantity of blood to the brain* and producing that periodical condition of the nervous system we call *sleep*, the activities of the higher nerve centers ceasing either partially or wholly. During sleep nutrition and force is restored and waste products removed. The loss of sleep is one of the great causes of insanity.

3. Avoid, vigorously, the use of alcohols. (See ALCOHOL.)

4. Avoid cerebral overwork.

5. Excessive eating and drinking may produce congestion.

6. Exposure to dampness and cold may cause inflammation of the spinal membranes extending to the cerebral pia mater and arachnoid.

7. HAVE A SYSTEMATIC HABIT OF THINKING.

#### THE EYE.

1. Give the eye exercise, then rest it as you would any other organ.

2. Those who read much should often look at distant objects.

3. Avoid facing the light of a lamp or window while reading; when possible, let the light fall over your shoulder.

4. Avoid reading by twilight.

5. Avoid reading immediately on rising in the morning before the eyes are accustomed to the light.

6. Avoid impure air, dust, smoke, etc. whenever possible.

7. Close application has a tendency to shorten the sight and weaken the eyes.

8. Remove dust or cinders by turning the lid back over a lead pencil and using silk or soft linen.

9. Avoid all oblique positions of the eye.

10. *Myopia* (short-sightedness) corrected by concave glasses.

† 11. *Hyper metropia* (long-sightedness) corrected by convex glasses.

12. *Presbyopia* (loss of power of accommodation) remedied by convex glasses.

13. Always remember the body sympathy existing and be attentive to care for the *entire physical being*.

14. *Amaurosis* (paralysis of the retina) results from using the eye too long in very intense light.

#### THE EAR.

1. Should there be an over-accumulation or hardening of the cerumen, use a few drops of sweet oil; or inject tepid soft water with a syringe.

2. The Eustachian tube may become obstructed in consequence of colds, etc. which should be avoided by proper clothing, ventilation, &c.

3. Persons who are recovering from severe throat affections or scarlet fever should be extremely careful lest a permanent discharge from the ear take place.

4. In dullness of hearing as long as you can hear the ticking of a watch placed against the side of the head there is yet hope.

#### THE BONES.

1. Avoid allowing children to sit alone too early when the bones are soft or the result may be a crooked spine.

2. Avoid allowing children to walk too early or the result may be knock-kneed or bandy-legged.

3. Regular exercise should be taken.

4. Avoid compressing the chest.

5. Maintain as far as possible an upright position in standing, walking or sitting.

6. Give special attention to diseases of the bones, particularly fractures and sprained ligaments. *Rest* is absolutely essential. *Felons*, as they originate beneath the periosteum, may be cured by making an incision *through* the periosteum.

7. The aged bone is brittle and breaks easily and is two or three times longer in "knitting" than the young bone.

8. *Good, wholesome nutritious food.*

#### THE TEETH.

1. Remove all teeth past filling and avoid neuralgic pains and maxillary abscess.

2. Avoid picking the teeth with hard substances.

3. The breaking of the enamel results in rapid decay unless the teeth be filled by a competent dentist.

4. Remove the loose teeth of children at once that they may not interfere with the form and position of the new permanent teeth.

5. Cleanse the teeth with brush and soft water.

6. Occasionally draw a thread between them.

7. Avoid the fruits that "set the teeth on edge."

8. Avoid acids, or if taken at once rinse out the mouth with some weak alkaline solution.

9. The Persalts of iron injure the teeth, and should be administered through a glass tube.

10. Vigorously reject most "patent" articles for the teeth.

#### THE NERVES.

1. The *prime necessity* for the highest welfare of the nerves is to preserve the *general health* of the body.

2. Don't do heavy brain-work awhile and then be idle.

3. Have a systematic habit of thinking.

4. Employment is indispensable.

5. A variety of subjects upon which to think is healthful.

6. Avoid excessive use of alcohol, opium and tobacco.

7. Avoid losing sleep for vain amusements.

8. Keep cheerful: despondency is health-destroying.

9. Avoid overworking the nervous tissue of children; try to judge of the quality of different brains.

10. Rest the brain and nerves by changing from one study to that of another for awhile.

11. Anxiety, mental emotion, or exposure to damp and cold may bring on neuralgia or sciatica.

12. Pure food, pure air, and *good habits* are absolutely essential to the preservation of a healthful state of the nerves.

#### ORGANS OF RESPIRATION.

1. Those having weak lungs should avoid exposure to certain kinds of dust arising from metals, stones, confined air, etc.

2. Avoid all things that suddenly check the perspiration, such as exposure to cold when heated, or changing from heavy to light clothing.

3. Avoid compression of the chest, lest it reduce the capacity of the lungs.

4. The air should be pure; therefore look to the location of dwelling houses, away from cesspools, slaughter houses, swamps, etc., and to keeping the cellars in proper condition.

5. Allow fresh air to enter the rooms, avoiding a draft across the sleeper.

6. Never allow many persons in the sick room for any length of time without thorough ventilation.

7. Avoid sitting in crowded halls or churches realizing that you are becoming stupefied by foul air. Suggest some method of ventilation and quietly leave unless ventilation is secured.

8. *Indolence*, or the want of due exercise in the open air, next to taking cold, is the most common cause of lung trouble.

#### MUSCLES.

1. *Use* them frequently and regularly.

2. *Rest* them gradually.

3. Don't bend over too long at a time. Throw back the shoulders, expand the chest.

4. Avoid leaning on the hip-joints; stand erect.
5. Give all the muscles their share of exercise according to the age and health.
6. Avoid exercising vigorously just before and after meals.
7. The morning hours are better for exercise than the evening. The same is true of the intellectual powers.
8. *Train and educate* your muscles and in this way attain skillfulness in all your work.

THE HEART, ARTERIES, CAPILLARIES AND VEINS.

1. Frequent bathing in the morning hours.
2. Zealously avoid compression on any parts.
3. Avoid wearing anything tight around the neck, lest the brain be deprived of its arterial blood and a return of the venous blood.
4. *Exercise and temperance.*
5. Preserve as far as possible an equal temperature.
6. If an artery be wounded compress it on that side of the wound towards the heart.
7. If a vein is wounded, compress it on that side towards the capillaries.
8. Avoid alcohol since it is a powerful motor-depressant.
9. Pure air, pure food, pure drink, sound sleep and cold bathing.

FOOD.

1. The supply must equal the waste of the system.
2. The less exercise the less food; the more exercise the more food.
3. Study to know whether the food is suited to the present state of the organs of digestion.
4. It must be properly cooked, suited to the season and climate, and of agreeable temperature.
5. It should be ground by the *teeth*, not sent down to impose upon the functions of the stomach.



6. Eat leisurely, and at regular hours.

7. Cheerfulness and pure air aid wonderfully in digestion.

8. Proper exercise of brain and muscle.

9. It is not best to drink while eating (see SALIVA).

10. Avoid eating heartily just before going to bed lest "colicky pains" be the result.

11. *Avoid excess.*

DIGESTIBILITY OF FOODS		TIME		DIGESTIBILITY OF FOODS		TIME	
		hr	m			hr	m
Beefsteak, broiled	...	3	00	Oysters, stewed	....	3	30
Beans, " "	....	2	30	Potatoes, roasted	....	2	30
Beets, " "	....	3	45	" boiled	....	3	00
Chicken, boiled	....	4	00	Parsnips " "	....	2	30
Ducks, roasted	....	4	00	Pork, roasted	....	5	15
Cabbage, boiled	...	4	30	Sausage, broiled	....	3	20
Eggs, boiled hard	...	3	30	Soup, chicken, boiled	...	3	00
" " soft	...	3	00	" mutton "	...	3	30
" whipped	....	1	30	" bean "	...	3	00
Green corn, boiled	...	3	45	" barley "	...	1	30
Liver, (beef) broiled	...	2	00	Turnips, boiled	....	3	30
Lamb, broiled	....	2	30	Turkey, roasted	....	2	25
Oysters, raw	....	2	55	Veal, broiled	....	4	00

#### COMPOSITION.

	Water	Album'n	Starch	Sugar	Fats	Salts
	%	%	%	%	%	%
Bread	37.0	8.1	47.4	3.6	1.6	2.3
Milk	86.0	4.1	...	5.2	3.9	.8
Eggs	74.0	14.0	...	...	10.5	1.5
Potatoes	75.0	2.1	18.8	3.2	.2	.7
Meat	54.0	27.6	...	...	15.45	2.95
Corn	14.0	11.1	64.7	.4	8.1	1.7
Oatmeal	15.0	12.6	58.4	5.4	5.6	3.0
Turnips	91.0	1.2	5.1	2.1	...	6.0
Rice	13.0	6.3	79.1	.4	.7	.5
Carrots	83.0	1.3	8.4	6.1	.2	1.0



2. Foods are (1) *Nitrogenous*, (2) *Non-Nitrogenous*.

1. Nitrogenous (albumin and albuminose), make blood and give nutrition.

2. Non-Nitrogenous (fats, sugars, and starch) keep up heat by (1) yielding hydrogen (in brain, muscles, blood and chyle) and (2) carbon to be exhibited by the lungs and skin.

#### THE SENSE OF SMELL.

1. Avoid snuff.

2. Avoid the practice of smelling pungent medicines.

3. Inflammation of the mucous membrane may take place more or less impairing, if not entirely abolishing the sense of smell from the following causes: (1) Exposure of feet and ankles to cold and dampness. (2) Exposure of the neck to a draft of cold air. (3) Atmospherical changes. (4) Inhalation of irritating vapors or dust.

#### THE SKIN.

1. Cold sponging of the body.

2. Clothing—clean and dry and adapted to the age, occupation and health.

3. Clothing—should be porous and loosely fitting.

4. For the unpleasant odor sometimes produced by exhalations from the skin, wash in a basin of water containing 1 to 2 tablespoonfuls of spirits of ammonia.

5. For *Corns*, etc.—soak them in some alkaline solution, remove them when softened, and then avoid the cause.

6. *Warts* may be burnt off with acid, or sometimes blue vitriol (1 oz.) in  $\frac{1}{2}$  pint of rain water frequently rubbed on will answer the purpose.

#### ABSORPTION.

1. Moisture increases the activity of the absorbents.

2. Alcohol and tobacco increase the liability to disease by stimulating the absorbent vessels.

3. Nutritious food decreases the activity of the absorbents.

4. Bed-rooms must be properly ventilated.

5. Dry apartments and healthy food are absolutely necessary in case of infectious disease.

6. Sick rooms should receive special attention since exhalations are greater at night and in sickness.

#### POISONS AND ANTIDOTES.

The figures number the course of treatment.

Arsenic,—(1) Vomit, (2) milk and raw eggs, (3) oil and lime water.

Strychnine,—(1) Emetic, (2) Flax seed tea, (3) Laudanum to relieve spasms.

Mercury,—(1) Albumen instantly, (2) Milk and wheat flour, (3) Flax seed tea.

Alkalies,—(1) Vinegar, (2) Lemon Juice, (3) Castor Oil.

Alcohol,—(1) Emetic by warm water and salt (repeat), (2) Strong coffee, (3) Galvanism.

Chloroform,—(1) Lower head, (2) Elevate legs, (3) Inhalation of ammonia, (4) Electricity.

Tin,—(1) Flour and water (2) Then Emetic, (3) Albumen.

Copper,—(1) Plenty milk and white of eggs, (2) warm water, (3) Then strong tea.

Opium,—(1) Emetic quickly, (2) Do anything to keep him awake, (3) Mustard plaster to calf of each leg.

Prussic Acid,—(1) Hyperdermic of atropia, (2) Ammonia, (3) cold to head, chest and spine, (4) Mustard to stomach.

Other Acids,—(1) 1 oz. magnesia in wine glass of water, (2) soft soap, (3) Plenty of warm water.

Lead,—(1) 2 oz. Epsom salts in pint of water, wine glass full every 10 minutes till bowels move freely.

Bee stings,—(1) Salt and water on part, (2) Oil and Ammonia rubbed on.

Bites of Serpents,—(1) Suck the wound, (2) Drink whisky freely.

## ALCOHOL.

1. A liquid composed of 91% by weight (94% by volume) of ethyl alcohol ( $C_2H_5HO$ ; 46), and 9% by weight (6% by volume) of water.

2. *Specific gravity* .820 at 60° Fahrenheit.

3. Boils at 78° centigrade.

*Remark:* To change from degrees Fahrenheit to centigrade,—Subtract 32 and divide by 1.8—or From degrees centigrade to Fahrenheit,—Multiply by 1.8 and add 32.

4. It is transparent, colorless and volatile.

5. It has a pungent agreeable odor and a burning taste.

6. It is usually obtained from whisky by distillation, being a derivative of sugar.

7. The term ALCOHOL should include all carbon compounds called alcohol or *malt* and *spirituous liquors* when studying its effects upon the human system.

8. *Whiskey* is an alcoholic liquid obtained by the distillation of fermented grain.

9. *Fermentation*, is decomposition taking place in organic bodies when exposed to the action of moisture, air and a warm atmosphere.

10. The present THEORY of fermentation is that it is caused by the presence of certain micro-organisms known as *bacteria*.

11. WHISKEY is prepared from grain by

1. *Mashing*, by which the starch is changed into sugar.

2. *Fermentation*, by which the sugar is converted into alcohol.

3. *Distillation*, by which the alcohol is separated as crude spirits.

12. Cane sugar is decomposed into alcohol on exposure to the action of *air, water* and a *warm temperature*, and is thought to be caused by a microscopic plant bearing the name of *Torula cerevisial*.

13. If alcohol and water be mixed a contraction of volume takes place; 45 gallons of water added to 55 gallons of alcohol will make only  $96\frac{1}{4}$  gallons; i. e. a loss in *volume* of  $3\frac{3}{4}$  gallons.

14. *Alcohol* or acetic acid may be produced by the action of dilute acids and ferments on cellulin or starch.

ALCOHOLIC LIQUIDS.	THE SOURCE FROM WHICH THEY ARE DERIVED.	% ALC
Whiskey...	Rye, corn, barley, potatoes or cider.	50
Rum.....	Fermented molasses.....	53
Brandy....	Grapes (wine).....	50
Red Wine..	Grapes with skins.....	12
White Wine.	Grapes without seeds, stems or skins	12
Port Wine..	Generally made artificially.....	40
Claret.....	Alc'l, tannic acid, &c., with coloring	6
Beer.....	From any malted grain, flavored with hops (yeast falling).....	3
Ale.....	By rapid fermentation, (yeast floating).....	6
Porter.....	About the same, with much coloring matter.....	6
Champagne.	Catawba, &c., (sweet, bottled before fermentation ceases).....	12
Common Gin	Barley, rye or potatoes, and rectified from turpentine.....	50
Holland Gin.	Matled barley, rye meal with hops, and rectified from juniper berries	51

## EFFECTS OF ALCOHOL.

1. A diffusible *stimulant* (very small doses).

2. A *motor-depressant*; *i. e.*, lowering the functional activity of the *spinal cord* and *motor apparatus*, and will *paralyze* them immediately if taken in large doses.

3. A *cerebral-excitant*, *i. e.*, increasing the activity of the *cerebrum* without depressing or entirely suspending brain-function (very small doses).

4. A *deliriant*, exciting the activity of the *higher brain* until the mental faculties are disordered, giving rise to intellectual confusion, loss of will-power, convulsions and delirium.

5. A *cerebral depressant*, *i. e.*, suspending the functions of the *higher brain* after a short period of excitement by acting on the cells, first stimulating their functions, then producing stupor, or coma and insensibility.

6. A *narcotic*, *i. e.*, lessening the relationship of a person to the external world, first exciting, then causing profound sleep by increasing stupor.

### 7. EFFECT ON THE CEREBELLUM (Equilibrium).

1. Specifically affected by alcohol.

2. Large doses cause a staggering gait and a tendency to fall.

3. Different preparations of alcohol affect different parts of the cerebellum.

4. Intoxication by beer or wine, is said to give a tendency to fall sideways.

5. Intoxication by whiskey, an inclination to fall on the face.

6. Intoxication by cider, a tendency to fall backwards.

N. B.—These disturbances correspond exactly with disturbances from injury to different lobes of the CEREBELLUM, ascertained by pains-taking investigation.



8. The *delirium* and *hallucinations* produced by alcohol, are caused in all probability by the action exerted on the angular gyrus and occipital lobes of the CEREBRUM. The objects arising being invariably snakes, frogs, dogs, etc.

9. A *respiratory* depressant, *i. e.*, renders breathing slow and shallow by action on the respiratory nerve centers.

10. A *vascular* stimulant; *i. e.*, increases the peripheral circulation.

11. A gastric tonic (in small doses) stimulating the local circulation.

12. Alcohol lessens the production of bile by lowering the functional activity of the liver.

13. A *diaphoretic*,—*i. e.*, increasing the action of the skin, promoting the secretion of sweat.

#### ABRIDGMENT OF THE PHYSIOLOGICAL ACTIONS OF ALCOHOL.

1. A cerebral-excitant,
2. A cerebral-depressant,
3. A narcotic poison,
4. An anesthetic,
5. A mild counter-irritant,
6. A motor depressant,
7. A respiratory-depressant,
8. Coagulates albumen by abstracting its water.
9. Partly *oxidized* by the organism, and partly *secreted*.

Taken in small amounts frequent and continued the following results :

1. It congests the *stomach* and *liver*.
2. Over stimulates the *gastric glands* and *hepatic cells*, causing gastric catarrh, then morning vomiting of mucus, greatly impairing digestion.
3. Depresses the *heart* and *arterial* tension.
4. Produces fatty degeneration of the *blood*, walls of the *arteries* and *veins*.

By a long continued use, the following results may take place:



1. *Epilepsy*,—a loss of consciousness with more or less general convulsions.

2. *Paraplegia*,—palsy of the upper or lower half of the body.

3. *Amaurosis*,—a diminution or total loss of sight.

4. *INSANITY*,—madness, and may be either :

1. *Moral*, a perversion of natural feelings and affections,

2. *Monomania*, understanding partially disordered under the influence of some particular topic or illusion.

3. *Mania*,—the *mind* in a state of *morbid* excitement the individual talking absurdly on every subject to which his thoughts are momentarily directed.

4. *Incoherence*.—a confounded or destroyed connection or associations of *ideas*.

IN LARGE AMOUNTS, as follows :

1. Destroys the activity of pepsin, *arresting* digestion.

2. Promotes exhilaration,

3. Intoxication,

4. Hallucinations,

5. Delirium,

6. *Inco-ordination of movement*,

7. *Depresses the heart*.

IN VERY LARGE AMOUNTS. (Toxic doses) it produces :

1. A brief excitement,

2. Insensibility,

3. Stertorous breathing,

4. *Complete muscular resolution*,

5. *Death* by paralysis of the heart and respiration.

N. B. *In health, alcohol is always decidedly injurious*. In the hands of the physician, it is a valuable agent for appropriate cases.—It has a strong affinity for the *nervous system*, and thus influences *sensation, motion, language, mental and moral* manifestations. Maintain a *constant watch, at all times*, against the use of alcohol in *any form, in health*.

## A BRIEF OUTLINE OF LESSONS ON THE HUMAN BODY.

For use in short lectures or conversational exercises.

### INTRODUCTION.

Explanation of such terms as cell, epithelium, tissue, organ, system, apparatus, anatomy, physiology, hygiene, some of those entering into the composition, as oxygen, hydrogen, nitrogen, carbon, etc.

### MOTOR APPARATUS.

#### 1. TISSUES.—

1. Fibrous, white and yellow, where found.
2. Areolar, where found, uses.
3. Adipose, where found, uses.
4. Muscular,
5. Cartilage, or gristle, etc.

#### 2. BONES.—

1. Number of bones.
2. Divisions as to size and form.
3. Composition of bones, (1) animal, (2) mineral matter.
4. Color of bones, (1) in the body, (2) out of, and removed from.
5. Lining of bones, (1) periosteum, (2) endosteum.
6. Divisions as to location :
  - A. Bones of the head : (1) skull bones, (2) face bones, (3) ear bones.
  - B. Bones of trunk : (1) at root of tongue, (2) those of spinal column, (3) sternum, (4) ribs, (5) of pelvis.
  - C. Bones of upper extremities : (1) clavical, (2) scapula, (3) humerus, (4) ulna and radius, (5) carpus, (6) metacarpus, (7) phalanges.
  - D. Bones of lower extremities : (1) femur, (2) patella, (3) tibia, (4) fibula, (5) tarsus, (6) meta-tarsus, (7) phalanges.

7. Functions: (1) to serve as attachment for muscles, (2) to protect important organs, (3) to preserve the shape of the body, (4) to prevent the body from sinking by its own weight.

8. Hygiene of bones: (1) consider exercise, (2) position, (3) compression, (4) fracture or diseased bones, (5) compare old and young as to strength, (6) food, etc.

### 3. ARTICULATIONS.—

1. Immovable, as sutures of skull.

2. Mixed, as between bodies of vertebræ.

3. Movable, as hip and shoulder joints, etc.

### 4. MUSCLES.—

1. Their number,

2. Origin and insertion or attachment,

3. Arrangement—in pairs, except 12.

4. Color—derived from blood-vessels.

5. Divisions as related to the will: (1) voluntary, (2) involuntary.

6. Divisions as to motion: (4) flexors, (2) extensors.

7. Functions:—(1) to invest and move bones, (2) to protect joints, (3) to form walls (parietes), (4) to give form, (5) to enclose cavities, (6) to move different parts of the body. Their uses are manifold.

8. Hygiene;—(1) Consider the necessity of pure air, (2) frequent, regular, and appropriate exercise, (3) Mention healthful exercises, etc.

## NUTRITIVE APPARATUS.

### 1. MEMBRANES.—

1. Serous, form closed sacs.

2. Mucous, never form closed sacs.

3. Synovial, line joints.

### 2. DIGESTIVE ORGANS.

1. The Mouth and tongue,

2. The Teeth,
3. The Salivary glands ;—(1) Parotid, (2) sub-maxillary, (3) sub-lingual.
4. The pharynx,
5. The œsophagus,
6. The stomach and intestines—secretions and uses; describe process of digestion.
7. The liver,
8. The pancreas,
9. The spleen.
10. Hygiene ;—(1) Consider preservation of teeth, (2) use of tobacco and alcohol, (3) quality of food (4) relative value, etc.

### ABSORPTION.

#### 1. ABSORBENT VESSELS.

1. Certain blood vessels, and lymphatics.
2. Functions.—(1) To build up the system by the absorption of food, as along alimentary canal, (2) to carry away effete matter.
3. Examples of absorption,—(1) Absorption of fat in starvation and æstivation of animals, (2) Absorption of poison when the skin is broken, (3) sub-cutaneous injections of morphine.
4. Hygiene :—(1) Call attention to ventilating bedrooms, sick-rooms, etc., (2) clothing, (3) moisture, (4) nutritious food, etc.

### CIRCULATORY SYSTEM.

#### 1. ORGANS OF CIRCULATION.

1. The heart,—(1) Its divisions, (2) valves, (3) membranes.
2. The arteries,—(1) Use, (2) origin, (3) termination.
3. The veins,—(1) Use, (2) origin, (3) termination.
4. The capillaries, connect arteries and veins. Explain Composition of blood.

5. Hygiene,—(1) Call attention to the effect of exercise, (2) of wearing proper apparel, (3) equable temperature, etc.

## RESPIRATORY SYSTEM.

### 1. ORGANS OF RESPIRATION.

1. The larynx, capped by the epiglottis.
2. The trachea, branching into bronchi, etc.
3. The lungs, (which see).

4. Hygiene ;—(1) Call attention to the necessity of healthful locations, (2) of vitiated air of school-rooms, etc., etc.

## NERVOUS SYSTEM.

### 1. ITS DIVISIONS.

1. Cerebro—Spinal System, consisting of (1) brain and cranial nerves, (2) spinal cord and spinal nerves.

2. Sympathetic System, consisting of nerves and ganglia.

### 2. STRUCTURE.

1. Gray matter, (1) where found (2) use.
2. White matter, (1) where found, (2) use.

Distinguish between the *structure* of gray and white matter, also between the *functions* of motor and sensory nerves, velocity, etc.

### 3. Functions of the Nervous system.

4. Hygiene of the Nervous System.—(1) Consider the effects of indolence or the want of physical and mental exercise, (2) of insufficient sleep, (3) of alcohol, etc., (4) food, (5) air, etc.

## ORGANS OF SPECIAL SENSE.

## 1. THE TONGUE.

1. Its muscular character,
2. Mode of attachment,
3. Sense of taste,—where located.
4. Papillæ,
5. A guide in the selection of food.

## 2. THE NOSE.

1. Cavities.
2. By what lined.
3. Supplied with sensitive nerves of smell.
4. A guide in the selection of food.

## 3. THE EYE.

1. Eye-ball ; (1) Its diameters, (2) coats, (3) humors, (4) muscles, (5) equator, etc. (6) Full structure.
2. Appendages : (1) eye-lids, (2) eye-brows, (3) conjunctiva, (4) lachrymal glands, (5) ducts, etc.
3. Hygiene of the eye. (which see).

## 4. THE EAR.

1. External ear, (1) structure, (2) use.
2. Middle ear, (1) structure, (2) use.
3. Internal ear, (1) structure, (2) use.
4. Hygiene of the ear : (1) avoid inserting hard substances into the ear, (2) concussions, etc.

## 5. THE SKIN.

1. Its layers, (which see)
2. Glands, (1) sweat, (2) sebaceous.
3. Appendages of the skin (1) Hair, (2) Nails.
4. Hygiene of the skin (which see).



## SCHOOL HYGIENE.

## 1. Its IMPORTANCE.

"There can be no question that our public schools propagate contagious diseases to a certain extent among the very young, and that their insufficient ventilation or bad sanitary condition often deteriorates the constitution to the point of establishing diseases which sometimes produce death; sometimes lasting invalidism, making the individuals wretched; and sometimes simply enfeebled health, which imparts weakened constitutions to children and children."

It may be safely said that the edifices for educational purposes are exceptional, in which anything like the best known methods of thoroughly changing the air in the rooms exists. Ninety per cent. of the churches, also, which are intended for at least occasionally large audiences, are constructed with no adequate means of changing the air.

Again, children spend at most 1150 hours out of the 8766 in the year at school. How many *homes* exhibit any adequate attention to the matters of ventilation, or exhibit more than one-fifth the capacity for changing the air which science dictates? Cold drafts; drainage; seasonable clothing; cleanliness in clothing, house, yards, streets and alleys; the relations of clothing to the free exercise of the body, the circulation of the blood, free respiration, etc.; insufficient attention to matters of unwholesome excitements, work, rest, light, stimulants, food, narcotics, etc. It is not easy to see why all cases of ill-health prevailing among the youth of the State should be disposed of by classifying and laying them at the door of the school room.

2. The subject concerns not only the physical robustness of whole generations, but their intellectual stamina, moral dispositions and general happiness.

## VENTILATION.

1. It is supposed that from 8 to 10 cubic feet of air per minute is vitiated by each pupil by respiration, perspiration and exhalation from the person and clothing, *i. e.*: it is rendered unfit in that length of time to purify or properly oxygenize the blood when breathed.

2. To give to each of 50 pupils 266 cu.ft. of air (which would last them from 26 to 33 minutes, if the vitiated air be properly distributed) would require a room 34x28x14.

Without the admission of pure air it would become very unwholesome in 10 or 15 minutes.

3. The height of the room above 10 feet should not be counted in reckoning the amount of space for each pupil which space should not be *less* than 120 cubic feet. School rooms are from 13 to 18 feet high, owing to their size to give symmetry and proper lighting.

4. Air saturated with moisture weighs nearly 1% less at 70° F. than dry air at the same temperature.

5. Warm air is lighter than cold air, in the proportion of  $\frac{1}{196}$  to each increase of 1° F.

6. *Carbonic acid gas* ( $\text{CO}_2$ ) weighs 1.529 (about  $1\frac{1}{2}$  times) as much as air.

Air containing from 8 to 10 parts of  $\text{CO}_2$  to 10,000 parts of air is unfit for respiration. It is continually sent out of the lungs with the breath, the mixture being about 20° warmer than the air of the room, and is saturated with moisture and consequently rises. More carbon is ordinarily found at the top of a room than at the bottom as shown by experiments. The small amount of  $\text{CO}_2$  allowable in respirable air is diffused and only slightly increases its weight.

7. The elasticity of air is increased by heat. The hot air at the top presses the air below out of the room through any low opening. The hot air will make its escape upward if there is any opening in the upper part of the room, thus destroying the effect.

8. Although gasses of different densities and volumes of air at different temperatures tend to diffuse themselves, yet they are disposed to form in strata, moving over and under each other. Warm air moves toward upper openings; cold air admitted at the bottom of a warm room tends to move directly toward the stove draft or flue, without operating to furnish air for the occupants and tending only to make their feet cold.

9. Air tends to remain coldest and heaviest near cold outside walls (those some distance from the source of heat) and tends to sink, which favors a downward current along those walls and thus the hot air may rise to the ceiling, passing along to the surface of these cool walls, (cooler air) becoming cooler and sinking to the egress. This purest air, without reaching the pupils at all, may thus leave the room. If three or four exits be placed in the floor about half way across the room from the inner walls, this tendency of the warm air to find the colder walls may be made to assist the mingling of the fresh air throughout all the room.

10. Air is very rapidly cooled against cold windows and in cold days will produce downward currents occasioning rheumatic pains in the necks of children who may sit near these windows. This is obviated by double panes set air-tight with half inch of air between them. If the glazing be done in a dry atmosphere the moisture of the confined air is said not to form a frosty coating on the inside of the outer pane obscuring the light.

11. A tube allowing egress or ingress of air is practically only as large as its smallest part.

12. Air will ascend more freely in smooth cylindrical tubes than square or rough tubes of the same caliber since the air forced upwards tends like smoke to move in ascending rings.

13. As air ascends tubes it becomes cold and consequently contracts; the contraction may be so great

as to favor downward currents. This is obviated by having the upper ends at the top of the house slightly contracted.

14. The air in the room will sympathize with the direction of the wind, no matter how tight the house and windows may be. Hence hot air from the same hot air-chambers will not warm both windward and leeward rooms. The hot air should be supplied to such rooms from different air-chambers. (One for each room). It is better to admit the heated air 8 or 10 feet above the floor of the room, because the air will then be hotter on reaching the ceiling where its elastic force is needed. Tubes leading from the bottom of the room giving egress to the foul air should be twice the size of the tubes admitting heated air.

15. The provisions for ventilation in *any case* should be such as to secure for each person in a class room not less than 30 cubic feet of fresh air per minute, which must be introduced and thoroughly distributed without creating unpleasant draughts or causing any two parts of the room to differ in temperature more than  $2^{\circ}\text{F.}$ , or the maximum temperature to exceed  $70^{\circ}\text{F.}$  This means for a class room to contain 56 pupils, 28 cubic feet of air per second should be continuously furnished, distributed and removed during school sessions. The *velocity of the incoming air* should not exceed 2 feet per second at any point, where it is liable to strike on the pupil.

16. The capacity of air for moisture is increased by heating it; and air that is moist enough when cold may become very dry when heated irritating to the lungs and injurious to furniture. This thirst occasioned by the warm air may be satisfied by vapor from a shallow dish of water. This is quite too commonly neglected.

17. An open grate with fire in it is an excellent means of emitting from a room air supplied from a hot air chamber. But as a means of warming a room not supplied with warm air, it is nearly all that a

warming apparatus should *not* be. It creates cold currents from every door and window, becoming thus a prolific source of colds, rheumatisms and fevers. (Opinions differ as to the importance of fireplaces).

18. A raised window admits currents of air directly on the pupils; if lowered from the top all the warm air will go out. Cold currents are often established one going out (warm air) the other coming in (cold) and thus producing rheumatism in the parts of the body they strike. This may be partially obviated at least if a board 6 or 8 inches wide be closely fitted against the outside of the sash at the bottom so that the sash may be raised, then on raising the window no current would be admitted *below* the sash; while up between the upper and lower sash cold air will be pressed in to supply what is exhausted from the room by the stove. The warm light air will not escape down through this channel.

19. After all it is important to avoid, as much as possible, holding pupils too long in crowded rooms. It is a great advantage if they are allowed frequent changes and allowed to pass through large, well-ventilated halls.

NOTE.—There is not yet entire unanimity concerning the best methods of heating and ventilating school-rooms.

#### WINDOWS IN THEIR RELATION TO HEALTHY EYES.

1. The light should enter the room over the left side of the pupil. The glass taken collectively should measure from  $\frac{1}{6}$  to  $\frac{1}{4}$  of the area of the floor.

2. No desk should be at a greater distance from the nearest window than  $1\frac{1}{2}$  times the distance from the floor to the top of the window.

3. The light should strike the book as nearly at right angles with the page as possible.

4. The window should start about 4 feet from the floor, extending well towards the ceiling.



5. The ceiling should be white.
6. The walls are improved by bearing a neutral tint.
7. Light from the front, with plenty of other light, obscures vision by contracting the pupil, while it permanently injures the eye.

#### SEATS AND DESKS.

1. In country schools little children are too frequently obliged to occupy desks that keep the feet above the floor. The feet should always have support.

2. The desk should be high enough to enable the child or pupil to sit nearly erect while writing, but in no case should one shoulder be raised above the line of the other shoulder.

3. If the desk be too flat the pupil is led to throw part of his weight on the elbow, the head bowed over the book causing an engorgement of the blood vessels of the eye.

4. Seats should be shaped and situated so as to allow pupils to relieve themselves by slight changes of position and bearing.

5. The evils of poor seats may be obviated by school gymnastics and abundant exercise on the playground which will tend largely to symmetrical physical development.

#### HYGIENE OF THE EYE. (see same, former page).

1. Comfortable temperature, and feet warm and dry.
2. Good ventilation.
3. Erect position.
4. Light, in abundance but not dazzling.
5. Sun must not shine on objects in front of pupil.
6. The light must come from the left, or left and rear.



7. No study at all in twilight or late at night.
8. No light from the right of the pupil permitted.
9. Distance of book from eye about 15 inches.
10. Frequent rest by looking up.

#### SITE OF THE SCHOOL HOUSE.

In selecting a site for a school house the following points should receive attention.

1. Dampness, from lack of proper drainage, &c.
2. Malaria, from ponds of water, stagnant in dry weather.
3. Noises.
4. Nuisances, as glue factories, stable yards, slaughter-houses, &c.
5. An abundant supply of direct sunlight.
6. Size of play-ground, to secure free air and exercise, and not have pupils forced into the streets or public highways for their sports to acquire rude and boisterous manners in their treatment of passers by.

#### CLOSETS FOR CLOTHES.

1. If they open into the school-room, they may be the source of much foul air, *especially in damp weather*.
2. They furnish good opportunities for accumulating any tendency to propagate disease.
3. The closets for clothes should be so constructed as to insure the proper airing of garments.

The eye, ear, nose, etc., have been treated of in former pages of this work. There is room in the teacher's calling for all the knowledge he can acquire. The teacher largely influences the quality and effectiveness of the child's life in all its relations, physical as well as mental.

He should acquaint himself thoroughly with the following :

GENERAL POINTS.

1. *Drafts* of cold air (also drafts of hot air) occasion colds, inflammations and catarrhs which may affect the ears which are not only subject to diseases directly incident to their several parts, but also to sympathetic affections in consequence of the close relation existing between them and the teeth, the nose, and the throat, and from their connection with the brain and spinal cord.

2. The *External ear* may swell up as the result of blows, of frost, etc.

3. The *External canal* of the ear may be injured by the introduction of foreign bodies, or filled by an accumulation of wax.

4. The *drum of the ear* may be injured by concussion of the air, occasioned by violent blows, or by the continued contact of cold or salt water while children are swimming.

5. The *inner labyrinth* may be injured by whatever causes inflammation in it, or by diseases of the brain.

6. *Affections of the teeth* often affect the hearing (See former page for hygiene of teeth).

7. *Deafness* may be the result of a closing up of the Eustachian tube from the retention of mucus which it secretes, brought on from colds.

8. The *cavity of the nose*, crooked, its bony wall rolled in and in on itself, furnishes a very large area, covered by mucous membrane, full of blood vessels and nerves and quite liable to become inflamed when a pupil takes cold.

9. *Myopia* (lengthening of eyeball from front to rear) is, for the most part a diseased eye, and may be caused from the following :

1. Holding the eye for a long time without intermissions to distinguish very near objects.

2. Much confinement in the house, depriving it of that broad scope essential to the maintenance of the full power and elasticity of the muscles.

3. Straining the eye in consequence of defective light; small type; pale ink; greasy black boards (writing on); lead pencil writing, etc.

4. In short, anything producing engorgement of the blood vessels of the eye, as bending over books, continued anxious tension of mind, etc.

5. Impure air, overwork, discouragement or anything tending to weaken the system or diminish its vitality may aggravate or induce myopia.

(See WINDOWS IN THEIR RELATION TO THE EYES.)

We have given the opinions of some of our most thorough and able educators on these important subjects to teachers.

Suffice it to say the quality of *common sense* is of very great use to the teacher in matters of school hygiene, which quality he should by all proper means encourage in his pupils. "*Wisdom in planning and skill in performing*" should be his watchword.

## QUIZ DEPARTMENT.

---

The numbers at the end of each Question show the page where the answers may be found.

---

1. Define general and descriptive anatomy. 5
2. What is human physiology? 5
3. What is general and special physiology? 5
4. What does physiology in its modern application signify? 5
5. What is the meaning of hygiene and of what does it consist? 5
6. Name the principal divisions of human nature. 6
7. Of what does Osteology treat? Myology? Neurology? Angiology? Ichorology? Splanchnology? Histology? Pneumonology? Adenology? Dermatology? Syndesmology? 6
8. What is meant by the functions of a tissue or organ? 6
9. What is an apparatus? 6
10. Of what are tissues composed? 6
11. What is the type of the earliest form of life? 6
12. What is meant by growth? 6
13. Give a good example of a cell? 5
14. Name the different ways in which cells multiply. 7
15. Of what size are cells? 7
16. What is the character of the cell substance? 7
17. What is bioplasm? Carcode? 7
18. What transformations do cells undergo? 7
19. What is meant by the Original Structural Elements? 7

20. Name the different kinds of epithelium. 7
21. What is pavement or tassellated epithelium? 7
22. Where is it found? 7
23. What is its function? 7
24. What is columnar epithelium? 8
25. Where is it found? 8
26. Give its function. 8
27. Of what is spheroidal epithelium formed? 8  
Where found? Function? 8
28. Of what form is ciliated epithelium? Where  
found? Function? 8
29. What is the basement membrane? Structure?  
Composition? Thickness? 8
30. What is imbedded in the basement mem-  
brane? 8
31. Name the connective tissues. 9
32. How many forms has fibrous tissue? 9
33. From what is white fibrous tissue developed,  
and of what does it consist? 9
34. What membranes are mostly formed by this  
tissue? 9
35. What is the chief characteristic of yellow fib-  
rous tissue? 9
36. What organs are formed almost entirely of  
this form of tissue? 10
37. What is the areolar tissue? 10
38. What does its spaces contain? 10
39. Where is it found? 10
40. What produces general dropsy? 10
41. What is the adipose tissue? 10
42. Where is there none of this tissue? 10
43. Give the chemical composition of the body  
and state where each element is found. 11
44. State the number of chemical elements, also  
the number of proximate principles. 11

45. What part of the body weight does water form? 11

46. What offices are performed by water in the system? 11

47. How is water eliminated? 11

48. By what is animal heat produced? 11

49. What is the mean normal temperature? 11

50. What is oxygen? When first discovered? By whom? 11 and 12

51. Is oxygen necessary to our existence?

52. When is oxygen found? 12

53. How is oxygen absorbed into the arterial blood? 12

54. What is hydrogen? 12

55. Where is it found? 12

56. What is the effect of its inhalation? 12

57. When and by whom was the composition of water first discovered? 12

58. What is nitrogen? 12

59. From what kind of food is it probably derived? 13

60. What is carbon? Where found pure? 13

61. What is carbonic acid? 13

62. How does the body get rid of its carbon? 13

63. The total amount of blood is what part of the total body weight? 13

64. Give its chief characteristics. 13

65. What is its specific gravity? 13

66. Of what two parts does it naturally consist? Give the composition of each part. 13

67. Of what two parts does it consist after the blood is drawn? 14

68. Of what do the corpuscles consist? Use? 14

69. Name the two kinds of corpuscles and state how they compare as to number. 14



70. How many blood disks in a cubic millimeter of blood? 14

71. How long after breathing has ceased does blood coagulate in the body? 14

72. What is the function of the blood? 14

73. Of what does the circulatory apparatus consist? 14

74. What is the heart? 14

75. What is the pericardium? 14

76. What and where is the endocardium? 15

77. How is the heart joined to the vertebral column? 15

78. Give the average weight of the heart. 15

79. Into how many cavities is it divided, and what is the capacity and shape of each? 15

80. What part of the heart is occupied by the auricles? By the ventricles? 15

81. Where are the fibrous zones? How many? 15

82. What difference between the walls of auricles and ventricles as to thickness? 15

83. Tell how the valves are formed, give their number and locate them. 15

84. What seems to be the connecting link between voluntary and involuntary muscles? Why? 16

85. How many openings in each ventricle and in what part of it are they situated? 16

86. Give the average size and capacity of the heart. 16

87. How is the force of the heart ascertained? 16

88. How is the work done by the entire heart estimated? 16

89. What causes the contraction and dilation of the heart? 17

90. What time is required for the entire mass of blood to pass through the heart? 17

91. Give the average number of pulsations in the adult male and female per minute. 17

92. What are the arteries? 17

93. What is their function? 17

94. At what rate does the blood travel in the arteries? 17.

95. How many coats have arteries? Name and describe each. 17

96. With what are they endowed? 17

97. By what is the blood pressure influenced? 17

98. How is the caliber of blood vessels regulated? 18

99. What is the pulse? 18

100. How tell when an artery has been severed? 18

101. By what are arteries themselves nourished? 18

102. Where are the capillaries? 18

103. Give the diameters, also the thickness of their walls. 18

104. By what are they lined? 18

105. What two important functions take place through the agency of the capillaries? 18

106. At what rate does the blood flow through the capillaries? 18

107. What is the position of the red and white corpuscles in the capillaries? 18

108. To what parts do they distribute the blood? 18

109. What artery arises from the right ventricle of the heart? The left ventricle? 18-19

110. Begin with the aorta and name and locate its principal divisions. 19

111. Give the function of veins and name and describe their coats. 22

112. What is the main difference between arteries and veins? 23.

113. Of what use are valves? How formed? Of what do they consist? 23

114. Where are valves most numerous? 23
115. Where do all veins finally terminate? 23
116. To what is the flow of the blood in the veins mainly due? 23
117. From what three sources is the blood returned from every part of the body except the lungs? 24
118. State how the vena cava superior returns the blood to the heart. 24
119. In what manner does the vena cava inferior return the blood to the heart? 25
120. Trace minutely the cardiac and pulmonic circulation. When and by whom discovered? 27
121. Name the forces keeping the blood in circulation. 27 28
122. Name the organs of respiration. 28
123. Name the principal cartilages of the larynx and describe each. 28
124. Where are the vocal cords? How many kinds? 29
125. How are the false vocal cords formed? 29
126. Where is the sacculus laryngis and what is its function? 29
127. How are the true vocal cords formed? 29
128. Where is the glottis? Its dimensions? 29
129. What change in length of the vocal cords will produce change of note? 30
130. What is the trachea? Its extent? Diameter? 30
131. Describe the bronchi. 30
132. Of what is the trachea composed? Lined by what kind of epithelium? 30
133. Locate the lungs. By what separated? Shape? 30
134. Where is the apex? Base? 31
135. How many borders? Describe each. 31
136. How many surfaces? 31

137. What is the root of the lung? 31
138. How do the lungs differ to the size, length, and number of lobes? 31
139. Give the weight and specific gravity of the lungs? 31
140. Of what color are the lungs? How do you account for this? 31
141. Give the structure of the lungs. 32
142. Give the size and number of air-cells. 32
143. By what is the air and blood separated in the lungs? 32
144. From what arteries do the lungs receive their nutrition? 32
145. Give the area of the lung tissue. 32
146. What is the vital capacity of the lungs of a person of average stature? 32
147. How are the movements of the lungs called forth? 32
148. How many cubic feet of air passes in and out of the lungs in 24 hours? 32
149. What is meant by tidal air? Residual air? Reserve air? Complemental air? 32
150. What amount of oxygen imbibed from the air every 24 hours? 32
151. Amount of carbonic acid exhaled in 24 hours? 33
152. Name the principal nerves presiding over the lungs. 33
153. What is the function of the lungs? 33
154. Give the composition of bone. 33
155. How surrounded? Lined? 33
156. Of what does an Haversian System consist? 33
157. What are lacunæ? Lamellæ? Canaliculi? 33
158. What is medulla, and where found? 34
159. Give the manner of development of bones. 34

160. Define epiphysis, apiphysis and diaphysis. 34
161. What is the skeleton? Its weight? 34
162. Name the different kinds of bones of which the skeleton is composed and give the number of each. 34 35
163. Give the name and number of bones in each group into which the movable vertebræ is divided. 35
164. What two bones consist of united vertebræ? 35
165. Give the general characters of a vertebræ. 35
166. Describe the atlas and axis. 36 37
167. Name the peculiar dorsal. 37
168. What is the average length of the entire spine? 37
169. How many curves in it viewed sideways? 38
170. Give the number and classification of the ribs. 38
171. Locate the sternum and name its three segments. 38
172. Where is the os innominata? Acetabulum? 38
173. Where is the sacrum? Shape? Texture? 38 39
174. Where is the coccyx? Number of vertebræ? 39
175. Of what does the upper extremity consist? 39
176. Where is the scapula? Humerus? Glenoid cavity? 39
177. Where is the ulna? Olecranon process? Radius? 40
178. Which is the larger, the ulna or radius? 40
179. Which is the longer, the ulna or radius? 40
180. Name the carpal bones in the first row; in the second row. 40
181. Give the number of the first, second and third phalanges. 40
182. Which is the longest, strongest bone in the body? 41
183. With what bones does the femur articulate? 41

184. Describe the patella. 41
185. Locate and describe the tibia and fibula; which is the larger? 41
186. Which bone is most slender in proportion to its length of all long bones? 42
187. Does the fibula aid in the formation of the knee-joint? 42
188. Name the tarsal bones. 42
189. To what division of bones do the metatarsus belong? 42
190. Name and locate the bones of the cranium. 42
191. Name the bones of the face; give short description of each. 43
192. Name the bones of the ear. 43
193. Locate and describe the os hyoides. 45
194. Give the number and classification of joints. 45
195. Give the varieties of motion allowed. 45
196. Define sutures, gomphosis, schindylesis and lateral ginglymus. 45 46
197. Name the structures entering into the formation of joints. 46
198. Of what do ligaments consist? Where found? 46
199. Of what does cartilage consist? Kinds? Color? 47
200. Describe the following joints: shoulder, elbow, wrist, hip and knee. 47 48
201. Give the number of articulations, muscles attached, and developmental centers of any of the bones. 49
202. Name the two great systems of nerves. 49
203. Locate the cerebro-spinal system. 50
204. Of what does it consist? 50
205. Locate the sympathetic system. 50
206. Of what does it consist? 50
207. Name the two kinds of matter composing nervous tissue. 50



208. What is the gray matter? Describe its cells. 50
209. In what part of the brain and spinal cord is the gray matter found? 50
210. What are unipolar, bipolar and multipolar cells? 50
211. What is the function of gray matter? 50
212. Of what three parts does the white matter consist? Describe each part. 51
213. What is the function of the white matter? 51
214. How do nerves receive their nutrition? 51
215. Describe the central and peripheral endings of the motor nerve fibers. 50
216. Describe the form of connection between the motor nerves and voluntary muscle. 50
217. How do motor nerves end in involuntary muscle? 50
218. In how many ways do sensitive nerves end? Describe each. 51 52
219. Distinguish between efferent and afferent nerves. 52
220. What is the function of sensitive nerves? Motor nerves? Vasomotor? Trophic? Secretory? Inhibitory? 52
221. Can sensibility be destroyed without destroying motion? 52
222. Can motor nerves be paralyzed without affecting sensation? 52
223. At what rate do motor nerves conduct force? Sensory nerves? 52
224. Give the varieties of nervous stimuli. 52
225. Distinguish between a nerve and a commissure. 52
226. Where are ganglia? Where situated? 52 53
227. What is a plexus? 53
228. Distinguish fully between the roots of spinal nerves. 53

229. How many pairs of spinal nerves? Classify them. 53

230. What communication exists between the sympathetic and Cerebro-spinal systems? 54

231. The nerves of which system follow the distribution of blood vessels? 54

232. What are the distinguishing characteristics of the sympathetic nerves? 54

233. How does the brain of man compare with that of the lower order of animals? 54

234. At what age is the maximum weight of the brain reached? 54

235. Of what is the brain composed? 54

236. Is the brain only a generator of nerve force, or is it also a conductor of nervous impulses? 54

237. Name the 4 principal divisions of the brain. 55

238. Name the 3 membranes of the brain. 55

239. Describe the cerebrum, tell how it is supplied with blood, and how it is connected with the pons Varolii and medulla oblongata. 55

240. Where are impressions registered and reproduced as ideas? 55

241. Of how many lobes does the cerebrum consist? 56.

242. Locate the cerebellum, and state how it compares with the cerebrum in respect to size. 55

243. For what is the cerebellum the center? 56

244. With what portions of the brain does the pons Varolii unite? What purpose does it serve? 56

245. Of what acts is the pons Varolii the center? 56

246. What is the medulla oblongata? 56

247. Name in order the columns of the medulla oblongata. 57

248. Of what is the medulla oblongata center? 57

249. Describe the dura mater and state how the sinuses are formed. 57

250. Where is the Falx cerebri? Falx cerebelli? Tentorium? From what are these formed? Describe the arachnoid. To what class of membranes does it belong? 57

251. Where is the cerebro-spinal fluid found? 57

252. Describe the pia mater; where found? 58

253. Describe the spinal cord, giving its length, membranes and weight. 58.

254. What are the functions of the *nervous system*? 58

255. Name the cranial nerves giving the origin, properties, functions, and distributions of each. 59

256. What are muscles? 60

257. State how muscular fibers end that connect (1) with cartilage, (2) with bone, (3) with skin. 60

258. What is meant by the origin and insertion of muscles? 60

259. What are tendons and aponeuroses, and where are they situated? 60

260. Name the different classes of fascia and state the position and function of each. 60 61

261. Distinguish between voluntary and involuntary muscles. 61

262. Define perimysium and sarcolemma. 61

263. Of what are fibrils composed and what is their diameter? 61

264. What are striæ? Give their position. 61

265. What is *Rigor Mortis* and what seems to be the cause? 62

266. Distinguish between flexors and extensors. 62

267. Give the law of contractions and state the stimuli to which muscles re-act. 62.

268. How are muscles nourished? 62

269. Give the uses of muscles. 62

270. Give the origin, insertion and function of the diaphragm. 63

271. Name the 6 ways by which the names of the muscles originate. 64

272. Name the openings in the diaphragm and state what each transmits. 64

273. Bound the mouth. 64

274. Bound the isthmus of the fauces. 64

275. Give the divisions of the teeth and number in each. 65

276. Name the parts of a tooth and locate each. 65

277. When do deciduous teeth begin to appear? Entirely appear? 65

278. When do permanent teeth begin to appear? Entirely appear? 65

279. What is the greatest number of teeth in the jaws at any one time? When? 65

280. Of what does the hard substance of the tooth consist? 65

281. Where is the dentine and what does it enclose? 65

282. Give the use of the teeth. Are they parts of the skeleton? 65

283. Name the Salivary glands. 65 66

284. Where is the Parotid gland? Name its duct and state where it opens into the mouth. 65

285. Where is the Submaxillary gland? Name its duct and state where it opens into the mouth. 66

286. Where is the Sublingual gland? By what ducts does it open into the mouth? 66

287. Give the function of the salivary glands. 66

288. Name the muscles of the tongue. 66

289. To what is the tongue attached? 66

290. Name, locate and describe the 3 classes of papillæ. 66.

291. Where is the frænum linguæ? How formed? 66

292. Where is the sense of taste? 66

293. Where are the "Taste Buds"? Length? 66

294. Give the structure, shape, location and function of the tonsils. 66

295. What is the pharynx? 66

296. Locate the pharynx, giving its attachments above and below. 66

297. Name the 7 openings of the pharynx. 66

298. What is the œsophagus? 67

299. How many layers has the œsophagus? Name them. 67

300. What is the function of the œsophagus? 67

301. What is the principal organ of digestion? 67

302. What is the function of the stomach? 67

303. Locate the stomach? 67

304. Give the weight and openings of the stomach. 67

305. What part is the *cul de sac*? 67

306. Locate the openings of the stomach. 67

307. In what way does breathing affect the stomach? 67

308. Name and describe the coats of the stomach. 67

309. What is the average capacity of the stomach and how is it lined? 68

310. Locate the gastric and mucous gland of the stomach. 68

311. What causes the secretion of gastric juice? 68

312. Give the dimensions of the stomach and state how it is kept in place. 68

313. Name and give the combined length of the 3 parts of the small intestine and state how it is held in place. 68

314. Describe the duodenum. 68

315. What fluids are poured into the duodenum? 68

316. Describe the jejunum. 68

317. Describe and locate the *volvulæ conniventes*. 68

318. Describe, locate, and give the number of villi. 68

319. What and where are Brunner's glands and Crypts of Leiberkuhn? 69

320. Locate ileum. 69

321. What and where are the solitary glands? 69

322. What and where are Peyer's glands? 69

323. What fractional part of the alimentary canal does the colon form? 69

324. Give the divisions of the Colon. 69-70 (note)

325. In what respect does it differ from the small intestine in structure? 69

326. Describe, locate and give the dimensions of the cæcum. 69

327. Describe the appendix vermiformis. Length? 69

328. Locate the sigmoid flexure. Shape? 70

329. Locate, and describe the rectum. 70

330. Name the divisions of the alimentary canal and give its entire length. 70

331. Give the six steps of digestion and describe each. 70

332. Name the changes which take place in saccharine, albuminoid and oleaginous principles of food. 70

333. Name the agents of absorption. 71

334. What do the veins absorb and where is it conveyed? 71

335. How do the lymphatics originate? 71

336. Describe fully the thoracic duct; stating its length, diameter, origin and terminus. 71

337. Where do lacteals originate? End? 71

338. What substances absorbed by the lacteals? 71

339. Give the origin, composition, amount secreted and function of lymph and chyle. 71

340. Describe the peritoneum. 72



341. What is meant by omenta? Mesenteries? 72
342. Do the hepatic vessels reach the liver without perforating the membrane? 72
343. Locate the foramen of Winslow. 72
344. Name the ordinary divisions of the peritoneum. 72
345. What membrane is continuous with the skin? 73
346. Give the structure of the mucous membrane. 73
347. What membranes form shut sacs? 73
348. Give structure of serous membrane. 73
349. Describe the synovial membrane, and give its divisions as to situations. 73
350. Give the origin, composition, amount secreted and function of the following fluids: cerebro-spinal, saliva, gastric juice, pancreatic juice, intestinal juice, synovia, serous, mucous, endolymph, tears, sebum, meibomian, cerumen, perilymph, aqueous, milk, endolymph, liquor sanguinus, sweat, urine, breath, bile. 74 75.
351. Describe the pancreas, giving its location, length, weight, divisions and function. 76
352. Locate the canal of Wirsung. 76
353. How are the ductus communis choledochus formed? 76
354. Locate the liver and give its dimensions, position and weight. 76
355. How many ligaments, fissures and lobes has the liver? Classify them. 76
356. What is the proportion between the right and left lobes? 77
357. Describe the structure of the liver. 77
358. Describe the gall bladder as to position, shape, length, and capacity. 77
359. Show that the liver performs a *triple office*. 77
360. Where is bile formed? Function? 77

361. What is meant by the elaboration of blood? Glycogen? 77

362. Locate, give the shape, size, structure and function of the kidneys. 77 78

363. Describe the spleen as to dimensions, weight, texture, structure and function. 78 79

364. What is the suspensory ligament of the spleen? What is the Hilum? 78

365. Where is the splenic pulp? Malpighian corpuscles? 79

366. Has the spleen an excretory duct? 79

367. Name the tunics of the eye. 79

368. Name the refracting media. 79

369. What part of the outer tunic does the sclerotic form? Function? 79

370. How many surfaces has the sclerotic? Describe each. 79

371. How does the sclerotic join with the cornea? 80

372. What vessels found in sclerotic? 80

373. What part of the outer tunic is formed by the cornea? Its thickness? 80

374. How does the degree of curvature differ? 80

375. How many layers has the cornea? Describe each. 80

376. State the function of the elastic laminae. 80

377. What vessels found in cornea? 80

378. What part of the second tunic is formed by the choroid? Thickness? 80

379. How many layers has the choroid? Describe each layer. 81

380. Locate, describe, and give the number of ciliary processes. 81

381. Of what length are the ciliary processes and how are they attached? 81

382. Locate the iris, give its width and thickness and state by what it is perforated. 81

383. How does the pupil contract and expand? 81
384. How is the iris attached? 81
385. Why does the color of the iris vary? 82
386. On what part of the eye are the images received? 82
387. Describe the retina as its number of layers, thickness, extent and appearance. 82
388. Locate the yellow spot of Sæmmering. 82
389. Give the estimated number of optic nerve fibers, cones, pigment cells and rods. 82
390. Which way do the points of the rods and cones point? 82
391. What is the position and function of the rods, cones and pigment layers as to ethereal vibrations? 82
392. Give the position and quantity of aqueous humor. What is its function? 82 and 74
393. Locate the anterior and posterior chambers. 83
394. Locate the vitreous humor, tell how it is enclosed and give its function and shape. 74 and 83
395. Where is the crystalline lens? What is it? 83
396. Give the dimensions and weight of the crystalline lens. 83
397. What is the function of the crystalline lens and how does it receive its nutrition? 83
398. How is the crystalline lens held in position? 83-4
399. Where is the canal of Petit? 84
400. Describe the eye-ball as to its diameters, poles, axis, equator, and meridian planes. 84
401. What is it to see? 84
402. What is the conjunctiva? 84
403. What is the function of eye-lids? 84
404. Where are the lachrymal glands? What do they secrete? 74 and 85
405. What are the nasal fossæ, and what part is capable of receiving odorous impressions? 85
406. What is the ear and of what does it consist? 85

407. Describe the pinna and give its function. 85
408. Locate the helix, anti-helix, tragus, lobule, concha, and fossa of the helix. 85-86
409. What is the external meatus? Length? 86
410. Where are the glandulæ ceruminose, and what is their function? 86
411. Of what does the middle ear consist? 86
412. What is its length? How lined? Communicates with what? 87
413. Name and describe the bones of the middle ear. 87
414. How is sound transmitted across the tympanum? 87
415. Describe the Eustachian tube and give its function. 87
416. Where is the internal ear and of what does it consist? 87
417. Where is the vestibule? 87
418. Give the shape, communications and openings of the vestibule. 88
419. Give name and number of the semi-circular canals. 88
420. Describe the cochlea. 88
421. Where is the perilymph? 74 and 88
422. Describe the otoliths and state where found. 89
423. Where is the endolymph? 89
424. Describe the organ of Corti. 89
425. Give the estimated number of rods in the organ of Corti. 89
426. What is the function of the membranous cochlea and semi-circular canals? 89
427. What is it to hear? 89
428. Where is the membrana tympani? 86
429. What is the shape of the membrana tympani? Angle? Layers? 86

430. What is the function of the membrana tympani? 86

431. What is its position in appreciating high and low tones? 86

432. Describe the skin; give its thickness and number of sweat glands and the amount of evaporating surface. 90

433. What glands are found in the skin? Function? 90 and 74

434. How is the skin lubricated? 90

435. State the difference between sensible and insensible perspiration. 90

436. State the amount of carbonic acid exhaled from the skin. 90

437. What are the functions of the skin? 90

438. What is hair? 90

439. To what is the color of the hair due? 90

440. How is the hair softened? 91

441. Name and describe the parts of a hair? 91

442. What are the functions of hair? 91

443. What are nails? How formed? How fastened? 91

444. Where is the matrix? Lunula? 91

445. What is the pleuræ? Pleural cavity? 91

446. To what class of membrane do the pleura belong? 91

447. Where and what is the mediastinum? 92

448. What is contained in each pleural cavity? 92

449. Name and locate the skull bones. 92

450. What can you say of the importance of clothing, cleanliness, cold water and sleep? 95

451. Give the hygiene of the brain. 96

452. Give the hygiene of the eye. 97

453. How is myopia, hyper metropia and presbyopia corrected? 98

454. What is amaurosis and what causes it? 98
455. Give the hygiene of the ear. 98 (See also SCHOOL HYGIENE).
456. Give the hygiene of the bones. 98
457. Give the hygiene of the teeth. 99
458. Give the hygiene of the nerves. 99
459. Give the hygiene of the organs of respiration. 100
460. Give the hygiene of the muscles. 100
461. Give the hygiene of the organs of circulation. 101
462. Give the time required for the principal articles of food to digest. 102
463. Give the composition of bread, eggs, meat, etc. 102
464. Name the two general classes of food and state the functions of each. 103
465. Give hygiene of the sense of smell; also of the skin. 103
466. Give hygiene of absorbents. 103
467. Name several poisons and give their antidotes. 104
468. What is alcohol? 105 What does it include? 105
469. How change from F. to C. and from C. to F.? 105
470. How is alcohol usually obtained? 105
471. What is whiskey? Fermentation? 105
472. How is whiskey prepared from grain? 105 106
473. How is cane sugar decomposed into alcohol? 106
474. If alcohol and water be mixed, what change takes place in volume? 106
475. How may acetic acid and also alcohol be produced? 106



481. Give the source from which the principal alcoholic liquids are derived and the % of alcohol they contain. 106

482. Explain what is meant by alcohol being a "motor-depressant," "cerebral-depressant" and "narcotic." 107

483. Give the effects of alcohol on the cerebellum. 107

484. Account for delirium and hallucinations. 108

485. Why is alcohol a respiratory depressant? Vascular stimulant? Diaphoretic? 108

486. How does alcohol lessen the production of bile? 108

487. Give an abridged statement of the physiological actions of alcohol. 108

488. What is the result if taken in small amounts frequent and continued? 108

489. What are the results from a long continued use? 108 109

490. What is meant by epilepsy? Paraplegia? Amaurosis? Insanity? 109

491. Give the divisions of insanity and explain each. 109

492. What is the result if alcohol be taken in large amounts? *Very* large amounts? 109

493. Is alcohol always injurious in health? 109

494. *Why* does alcohol influence sensation, motion, language, mental and moral manifestations? 109

495. Explain how death is produced by toxic doses of alcohol. 109

496. Explain what causes inco-ordination of movement. 107

497. How does alcohol destroy the activity of the digestive organs? 108 109

498. Where is alcohol said to be a valuable agent sometimes? 109

499. Give a brief outline for lessons on the human body. 110

There are numerous other questions that might be asked, but we leave the teacher or pupil to his own tastes in enlarging the list. We omit questions on "School Hygiene" altogether.

## INDEX.

ANATOMY, definition	5	Cochlea, osseous.....	87
Absorption .....	71	membranous .....	88
hygiene of .....	104	Ciliary processes .....	81
Adipose tissue.....	10	Corti, organ of.....	89
Alimentary canal.....	70	Circulation of blood ..	27
Arteries.....	17	Cranial nerves, table..	63
Animal heat.....	11	Cerebrum.....	55
Axis cylinder, of nerves	51	Cerebellum.....	55
Air.....	11	Carbon.....	13
residual, complem't'l	32	Carbonic acid.....	33
Air-cells.....	32	Canaliculi.....	33
Alcohol.....	105	Centers, ossific.....	34
effects of.....	107	Coccyx.....	39
Articulations.....	45	Carpus.....	40
Arytenoid cartilages..	28	Cranium.....	42
Arachnoid.....	57	Cerebro-spinal system..	49
Antrum of Highmore..	43	Commissure.....	52
Aponeuroses .....	60	Crypts of Leiberkuhn..	69
Aqueous humor.....	83	Colon.....	69
Amaurosis.....	109	Cornea.....	80
Appendix vermiformis	69	Choroid.....	80
Appendices epiploical	69	Canal of Petit.....	84
Ampulla.....	88	Conjunctiva.....	84
		Capillaries.....	18
BLOOD.....	13	Corpuscles, origin of..	14
Bronchi.....	30	composition of.....	14
Basement membrane..	80	use of.....	14
Brain.....	54	Cartilage, use of.....	47
hygiene of.....	96		
Bile.....	77	DEFINITIONS.....	5
Brunner's glands.....	69	Dura mater.....	57
Bones.....	35	Duodenum.....	68
composition of.....	33	Ductus communis chol-	
hygiene of.....	98	edochus.....	76
		Digestion.....	70
CELLS.....	6	Diaphragm.....	63
Chemical composition		openings in.....	64
of body, table....	11		

EPIGLOTTIS.....	28	Hyaloid body.....	83
Epidermis.....	90	Hypermetropia.....	98
Ear.....	85	Hip-joint.....	48
hygiene of.....	98	Humerus.....	39
Epithelium.....	7	Hair, structure of....	91
Endolymph.....	89	function of.....	91
function of.....	75	Haversian canals <sup>4</sup> ....	33
Eye.....	79	spaces.....	34
hygiene of.....	97	Hydrogen.....	12
Ear-stones.....	89	Hygiene.....	94
Eye-ball.....	84	definition of.....	5
diameters of.....	84	Hepatic cells.....	77
Equator.....	84		
Epilepsy.....	109	IRIS.....	81
Eustachian tube.....	87	Isthmus fauces.....	64
Endocardium.....	15	Ileum.....	69
End bulbs.....	52	Ivory black.....	13
FOOD, nitrogenous and		Insanity.....	109
non-nitrogenous....	103	Intestines.....	68
composition of.....	102	Internal ear.....	87
digestibility of, table	102	Incoherence.....	109
Fermentation, theory.	105	Island of Reil.....	55
Fascia.....	60	Inferior maxillary....	45
Fingers.....	40		
Femur.....	41	JOINTS, number of..	45
Fibula.....	41	classes of.....	45
Face, bones of.....	43	formation of.....	46
Falx cerebri.....	57	Jejunum.....	68
cerbelli.....	57		
GALL-BLADDER....	77	KIDNEYS.....	77
Gastric juice.....	74	Knee-joint.....	48
secretion of.....	68		
function of.....	74	LUNGS, parts of....	31
Glycogen.....	77	weight of.....	31
Gasses.....	12	structure of.....	32
Glottis.....	29	air cells in.....	32
HEART.....	14	function of.....	33
force, how ascertain'd	16	root of.....	31
work, demonstration	16	Lymph, origin of....	71
		composition of.....	71
		function of.....	71

Liver.....	76	functions of.....	58
ligaments of.....	76	vaso-motor.....	52
fissure of.....	76	cerebro-spinal.....	49
lobes of.....	77	spinal.....	53
triple office of.....	77	lymphatic.....	54
Labyrinth, membran's	88	white & gray matter	50
osseous.....	87	spinal cord.....	58
Lens, crystalline.....	83	anterior and poster-	
Lacteals.....	71	ior roots.....	53
Lachrymal glands.....	85	cranial, table.....	63
bone.....	44	Neurilemma.....	51
Lower extremity.....	40	Nitrogen.....	12
Ligaments.....	46	Nails.....	91
description of.....	46	Nasal bone.....	44
Lacunæ.....	33		
Liquor sanguinis.....	13	OXYGEN.....	11
Lunula.....	91	Os hyoides.....	44
		Organs of respiration.	28
MYOPIA.....	98	hygiene of.....	100
Medulla.....	34	Os orbiculare.....	87
Medulla oblongata.....	56	Organ of hearing.....	85
Metatarsus.....	42	Osteology, abridgem't	
Mouth.....	64	of, table.....	49
Me normal temper-		Oesophagus.....	67
ature.....	11	Otoliths.....	89
Membrana Tympani..	86	Os innominatum.....	38
Mollastinum.....	92	Olfactory bulbs.....	85
Mesenteries.....	72		
Muscles.....	60	PHYSIOLOGY.....	5
hygiene of.....	100	definition of.....	5
table of.....	63	Pons varolii.....	56
Monomania.....	109	Prehension.....	70
Membranes.....	73	Presbyopia.....	98
Margighian corpuscles	78	Proximate principles..	11
		Pulse.....	18
NERVES.....	49	Perspiration.....	90
structure of.....	50	Parenchyma.....	32
hygiene of.....	99	Patella.....	41
fers, endings.....	51	Pericardium.....	14
te, velocity.....	52	Plexus, definition of..	53

Perilymph . . . . .	75	Sense of smell, hygiene	103
where found . . . . .	88	Saculus laryngis . . . . .	29
Pia mater . . . . .	58	Solitary glands . . . . .	69
Pancreas . . . . .	76	Sympath'c nerv's sy'm	54
Pharynx . . . . .	66	TEETH . . . . .	65
Pleuræ . . . . .	91	hygiene of . . . . .	99
Poisons and antidotes	104	Thoracic duct . . . . .	71
Peritoneum . . . . .	72	Table of alcohols . . . . .	106
Palate . . . . .	44	Tongue . . . . .	66
Pacinian corpuscles . . . . .	52	papillæ of . . . . .	66
RETINA . . . . .	82	Tactile corpuscles . . . . .	52
Respiration . . . . .	28	Touch, sense of . . . . .	52
Radius . . . . .	40	Tissue, white and yel-	
Rods of corti, number . . . . .	89	low fibers . . . . .	12
Ribs . . . . .	40	Areolar . . . . .	13
Rigor mortis . . . . .	62	Trachea . . . . .	30
SKIN . . . . .	90	Tarsus . . . . .	42
hygiene of . . . . .	103	Turbinated bones . . . . .	44
structure of . . . . .	90	Tubular membrane . . . . .	51
functions of . . . . .	90	Tonsils . . . . .	66
sweat glands in . . . . .	90	Tendons . . . . .	60
Semi-circular canals . . . . .	88	UTRICLE . . . . .	88
Scala vestibule . . . . .	88	Upper extremity . . . . .	39
Spinal cord . . . . .	58	Ulna . . . . .	40
Scala tympani . . . . .	88	VALVES . . . . .	23
Spleen . . . . .	78	Visual angle . . . . .	84
Stomach . . . . .	67	axis . . . . .	84
Skeleton . . . . .	34	Vena cava . . . . .	24
Sternum . . . . .	38	Vocal cords, true, false	29
Sutures . . . . .	45	Vitreous humor . . . . .	83
Superior Max. bone . . . . .	43	Vomer . . . . .	44
Sinuses . . . . .	60	Villi . . . . .	68
Shoulder-joint . . . . .	47	Valvulæ conniventes . . . . .	68
Sarcolemma . . . . .	61	Vertebræ, characters of	35
Sense of taste . . . . .	66	deviations . . . . .	36
Sclerotic coat of eye . . . . .	79	Vascular system . . . . .	14
Sleep . . . . .	96	Veins . . . . .	22
Skull-bones, abridgm't	92		



Vestibule.....	87	composition of and	
Vital capac'y of lungs.	32	by whom discov'd	12
		amount of in body..	11
WHISKY.....	105	What is it to see?...	84
White substance of...		What is it to hear?...	89
Schwann.....	51	Winslow, foramen of..	72
Water, use of.....	12	Wirsung, canal of...	76
how eleminated...	12	Yellow spot of retina.	82

# THE GOLDEN CHAIN,

CONSISTING OF FOUR GOLDEN LINKS,

<sup>1</sup>  
PHYSICAL,

<sup>2</sup>  
INTELLECTUAL,

<sup>3</sup>  
MORAL,

<sup>4</sup>  
DEVOTIONAL.

These are the golden links of man's nature; they are dependent upon each other, if one suffers all the others suffer with it and man is dwarfed or incomplete in proportion as he is deficient in any of these parts. Thus the work will consist of a full description of man physically, intellectually, morally and devotionally. This work was in part (third and fourth links) first written and published by S. S. Henderson and over 10,000 copies sold. The work is now undergoing a thorough revision in size and arrangement and will again be sent on its mission, teaching that the highest object of man's existence is to obey God, to love and serve mankind.

McKINLEY & HENDERSON, Pubs.,  
VAUGHNSVILLE, O.

TEACHERS AND STUDENTS,

THE RECORD STEAM PRINTING HOUSE,  
ADA, OHIO,

Makes a specialty of **SCHOOL WORK**, such as Diplomas, Commencement Programs, Grade Cards, Reward Cards, School Catalogues, Book Labels, Book and Pamphlet work. We do every kind of printing. Write us for prices. We have **SOMETHING NEW** in Reward or Remembrance Cards. Send for sample. Address as above.

# A VEST-POCKET MANUAL OF CIVIL GOVERNMENT

By GEO. W. HENDERSON.

Treating of Township, County, State and National Government. It is thorough and concise; may be and *should* be carried in the vest-pocket of every American citizen, and diligently studied. He who is practically ignorant of the fundamental principles that underlie the whole fabric of the Republic has no moral right to cast a vote. He who comes into his majority without an adequate knowledge of civil government is poorly equipped for the duties of citizenship, and his chances are decidedly in favor of his becoming a very dangerous voter. "Ignorance is always dangerous." On the other hand the more thorough the understanding is informed on the principles of government the more stable will everything become; the more vigorous will be the national development, the more healthful and stronger the general growth and the greater the sense of public security and the *less* the danger of plotters against society. It is the essential and responsible duty of every citizen to acquaint himself with the great principles of that government which is of the people, for the people and by the people, and for teachers and pupils it is of incalculable value in teaching and in preparing for examinations.

We publish the only vest pocket manual of civil government now before the public.

Price \$1.00. Now in Press.

**McKINLEY & HENDERSON, Publishers,**

VAUGHNSVILLE, PUTNAM CO., O.









QT H496t 1889

61320570R



NLM 05046432 6

NATIONAL LIBRARY OF MEDICINE